MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 8 JANUARY, 1936 Number 1

EDITORIAL STAFF

Editor

L. E. JERMY

Associate Editors

Allen F. Clark

Harold B. Veith

F. H. Burgess

New York . . . . . B. K. Price

Pittsburgh . . . E. A. France, Jr.

Chicago . . . . . W. G. Gude

Washington . . . . . L. M. Lamm

London . . . . . Vincent Delport

BUSINESS STAFF

Business Manager

J. D. Pease

Western Manager

H. H. Dreyer

Eastern Manager

J. F. Ahrens

Advertising Manager

C. E. Pask

A PENTON PUBLICATION

Published Monthly at

1213 West Third Street

Cleveland, Ohio

JOHN A. PENTON

Chairman of Board

C. J. Stark . *President and Treasurer*

J. D. Pease . *Executive Vice President*

F. V. Cole, *Vice President and Secretary*

George O. Hays . . *Vice President*

E. L. Shaner . . . *Vice President*

BRANCH OFFICES

New York . . . . 220 Broadway

Chicago . . . Peoples Gas Building

Pittsburgh . 1650 Koppers Building

London . . . . . Caxton House, Westminster, S. W. 1

CONTENTS

Page

Weight, Size Down—Utility, Sales Up 19
By H. W. Hem

Scanning the Field for Ideas 23

Synthetic Rubbers Resist Oil, Heat and Acids 26
By Allen F. Clark

Analyzing Fallacies in Design of Press Frames 30
By S. D. Brootzkoos

Assets to a Bookcase 33

Make Lighting System Integral with Machine! 34
By Harold B. Veith

Stress Concentration Leads to Design Failure 37
By Willis G. Meyers

New Machines Indicate Design Trends 41

Design Features in New Machines 42

Higher Production Necessary in Replacing Lost Physical Frontiers (Editorial) 44

Professional Viewpoints 45

How Is Business? 48

Men of Machines 50

Obituaries 54

Noteworthy Patents 58

New Materials and Parts 67

Calendar of Meetings 77

Manufacturers Publications 78

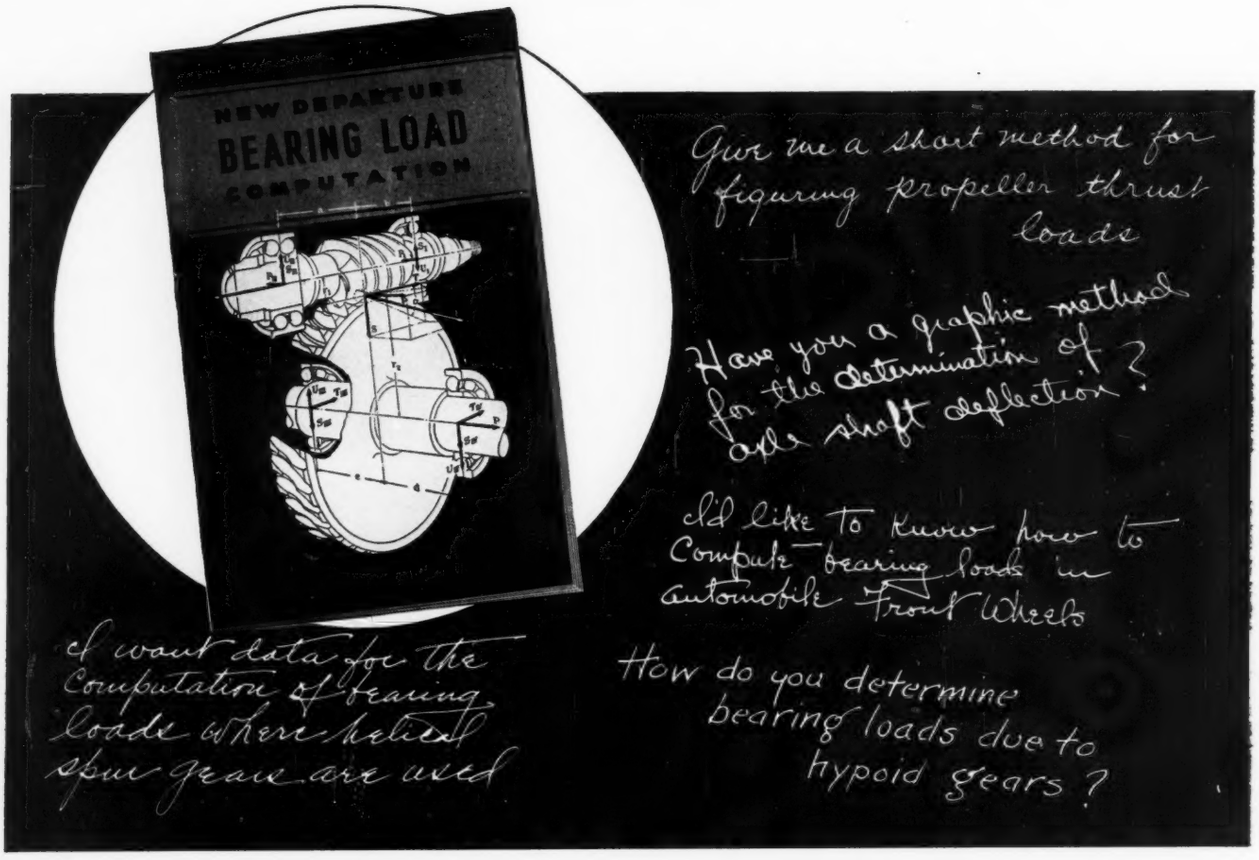
Business Announcements 81

Cross Sections 81

MACHINE DESIGN is published on the tenth of each month. Subscription rates: United States and possessions, Cuba and Mexico, two years $5; one year $3. Single copies 35 cents. Canada, one year $4.80, including duty. Great Britain and other European countries, two years £1.13.6; one year £1.00.

Copyright, 1936.

Acceptance under act of June 5, 1934, authorized July 20, 1934.


NEW DEPARTURE
BEARING LOAD
COMPUTATION
Give me a short method for figuring propeller thrust loads
Have you a graphic method for the determination of axle shaft deflection?
I'd like to know how to Compute bearing loads in automobile front wheels
I want data for the Computation of bearing loads where helical spur gears are used
How do you determine bearing loads due to hypoid gears?

DO YOU FIGURE BEARING LOADS?

— Then Here Is a Booklet You Need

NO matter what kind of machines you may be designing or what types of bearings you may plan to use, this booklet, with its perspective diagrams and convenient tables, will prove of real assistance. Methods used are the shortest consistent with accurate results. Send for your copy now. Simply ask for Booklet EL. . . . The New Departure Manufacturing Company, Bristol, Connecticut. World's Largest Producer of Quality Ball Bearings, including the Seal type.

Also Manufacturers of TRANSITORQ — Infinitely Variable Speed Power Unit

Itemized Index

CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

Design Calculations:

Bearing load capacities, Edit. 45L, 46
Frame stresses, Edit. 30, 31, 32, 33
Spring surge frequency, Edit. 47

Design Problems:

Bearings, determining load capacities of, Edit. 45L, 46
Fatigue, overcoming, Edit. 37, 38, 39, 40
Frames, selecting style of, Edit. 30, 31, 32, 33
Lights, building in, Edit. 34, 35, 36
Machining, eliminating, Edit. 23L
Rubber, applying synthetic, Edit. 26, 27, 28, 29
Size, reducing, Edit. 19, 20, 21, 22
Spring surge frequency, determining, Edit. 47
Stress concentration, eliminating, Edit. 37, 38, 39, 40
Weights, reducing, Edit. 19, 20, 21, 22

Finishes:

Electrodeposited, Edit. 74R
Enamels, Adv. 56L

Materials:

Alloys (Nickel), Adv. 55
Alloys (Steel), Edit. 69L, 70L
Aluminum, Edit. 20R, 21R, 22L
Cork, Edit. 28R, 29L
Felt, Adv. 15, 72L
Glass, Edit. 40R
Molybdenum, Adv. 14
Plastics, Edit. 22R, 74R; Adv. 70L
Rubber, Edit. 24R, 25, 26, 27, 28, 29
Steel, Edit. 38R, 39R, 40
Zinc, Adv. 51

Mechanisms:

Cam, Edit. 45
Contracting, Edit. 23
Conveying, Edit. 24R, 25L
Cutting, Edit. 58R, 60R
Feeding, Edit. 60R, 62R
Lever, Edit. 20, 21L
Measuring, Edit. 23R, 24L
Pneumatic, Edit. 25R
Slide, Edit. 24
Weighing, Edit. 20, 21, 22

Organization and Equipment:

Engineering department, Edit. 75L, 76R; Adv. 2, 12

Parts:

Bearings, Edit. 21, 24, 45L, 46, 68R, 69L; Adv. 6, 49, 52L, 59, 63, 67R, 76L
Clutches, Adv. 68L, 71R, 72L
Controls (Electrical), Edit. 23, 62R, 64R, 69L; Adv. 13, 84
Conveyors, Edit. 24R, 25L
Couplings, Adv. 74L
Drives, Edit. 29R, 67L, 68R, 70R, 74R, 75L; Adv. 3, 9, 17, 57, 73R, 82
Fastenings, Adv. 60L, 66L
Gears, Edit. 60R, 62R; Adv. 83
Hose, Edit. 27L, 28
Hydraulic equipment, Edit. 23, 60R, 62R, 71L, 72R; Adv. 10, 11, 54L
Lights, Edit. 34, 35, 36
Lubrication and lubricating equipment, Edit. 24, 70R, 71L, 73L, 74R
Motors (see also under Drives), Edit. 72R, 73L; Adv. 18, 53, 58L, 61, 65, 66L 69R, 79, 82
Packing glands and packing, Edit. 27R, 29, 66R; Adv. 4, 62L, 75R, 76L
Pumps, Edit. 28L, 29L, 67L, 74R, 75L; Adv. 64L, 68L, 78, 80L
Shims, Adv. 70L
Springs, Edit. 47
Valves, Edit. 25R, 26L, 29R
Welded parts and equipment, Edit. 23L, 33R, 56R, 72R; Adv. 8

Sales and Sales Department:

Increasing, through redesign, Edit. 19, 20, 21, 22

Key: Edit., Editorial Pages; Adv., Advertising Pages; R, Right hand column; L, Left hand column

Better . . because IT'S WELDED

● The modern gas range is *better because it's welded!* Welding makes a sturdier stove at less cost, eliminates chipping of enamel and insures lasting beauty—features that are inherent in jointless design and construction by welding.

Welding has made many good products better — stoves, automobiles, airplanes, radios, streamlined locomotives, metal furniture, and a thousand other things. You, too, may find it profitable to consider the advantages in both production and sales which can be gained for your products by jointless design-for-welding.

Linde engineers will gladly cooperate with you in the design or redesign of your products for welding. The benefit of their broad experience is available from Linde Sales Offices located in thirty principal cities throughout the country and at 30 East 42nd Street, New York, N. Y.

The Linde Air Products Company

Unit of Union Carbide and Carbon Corporation

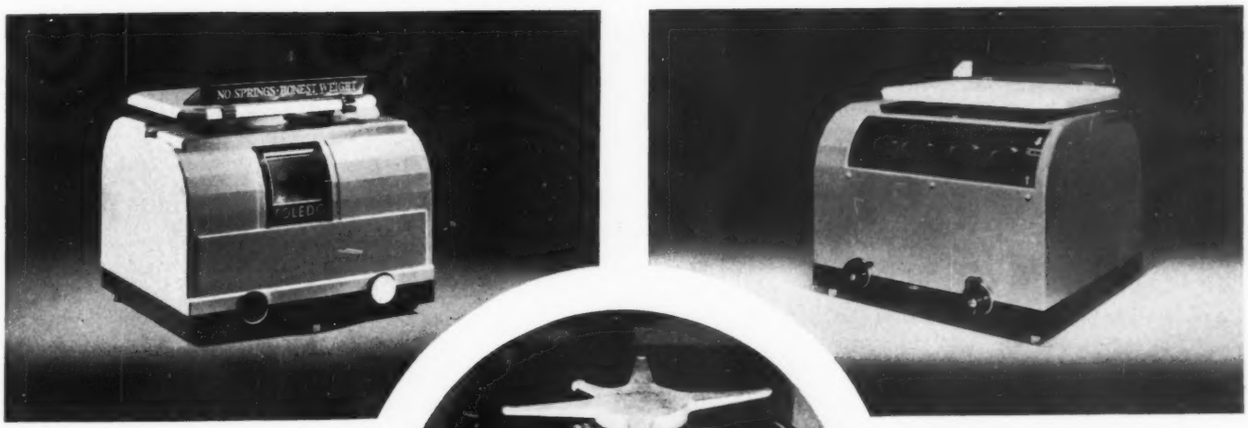
UCC

LINDE OXYGEN — UNION CARBIDE

PREST-O-LITE DISSOLVED ACETYLENE

OXWELD WELDING AND CUTTING APPARATUS AND SUPPLIES

MACHINE DESIGN



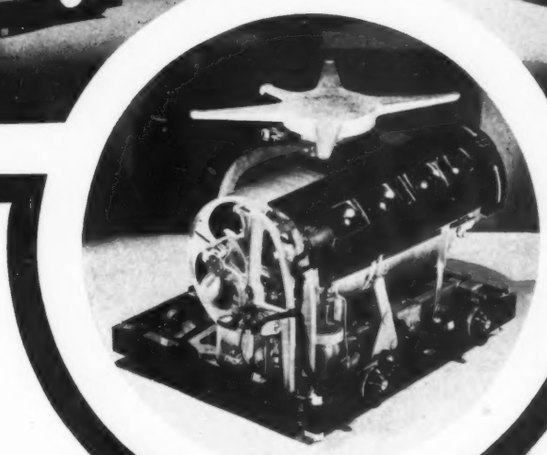


Fig. 1—Top—Plaskon scale, designed for performance and appearance. Fig. 2—Left—Its mechanism exemplifies compactness

Weight, Size Down— Utility, Sales Up

By H. W. Hem
Engineer, Toledo Scale Co.

CHANGE, the keynote of progress . . . Whether commercial or mechanical—in which case it is more appropriately called redesign —the ultimate objective is the same, perfection. Engineers frequently seek to reach that goal by savings in weight, reducing dimensions, and perhaps by increasing the service functions of the machine, as instanced by the Toledo Plas-

kon scale, *Fig.* 1, on which this discussion is based.

When the work of redesigning this scale from an upright model (*Fig.* 6) was completed, weight had been reduced from 165 to 55 pounds, the size was appreciably smaller and many in-

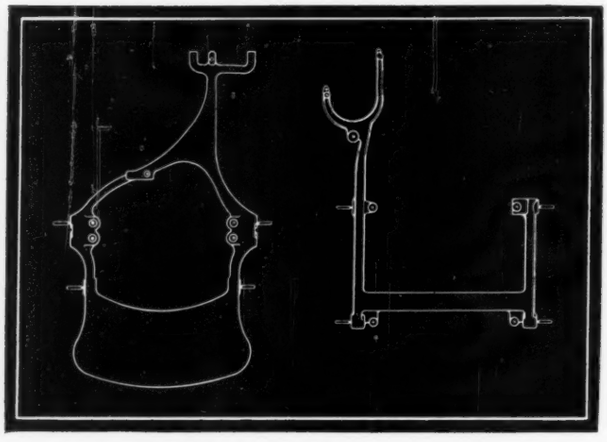


Fig. 3—*At left is shown the design of former type of main lever which the new design (right) supersedes. Note absence of counterweight on new member; also the increase in distance between pivot centers*

novations such as a plastic molded housing had been successfully applied. But most important of all is the fact that within sixty days of its announcement the sales of the new counter scale were exceeding those of all other retail models produced by the company.

Weighing mechanism of cylinder scales previously had been assembled in a vertical position; that is, there was a base on which were mounted the lever assembly and the platter. On the next level was the pendulum counterbalance, and crowning the entire assembly hung the computing chart. As a result the unit stood nearly 30 inches high, blocking the view between merchant and customer and presenting an ungainly appearance. Moreover, this earlier model was excessive in weight. It originally weighed under 100 pounds but with the adoption of porcelain finish came heavier castings, necessary to withstand the 1400 degrees temperature in the porcelain furnaces without changing dimensions. This boosted the weight to 165 pounds.

Mechanism Separated From Cover

In designing the new scale, Toledo engineers discarded all time-worn ideas of how a scale should look. As a first step they separated the weighing mechanism from the outer cover of the scale, which proved to be the key step to the success of the entire development. Where formerly the weighing mechanism and external appearance were completely tied in together, it now is possible for the scale designers to treat the mechanism, *Fig.* 2, without regard for limitations of cover or finish.

Computing chart *A*, *Fig.* 5, has been lowered to a position under the scale platter, with the pendulum counterbalancing mechanism placed at the end of the chart. Result: A reduction in height of 14½ inches. In the new scale the platter actually has been made larger, the lever spider arm *B* on which the load acts has been lengthened, the weight and stability of the pendulum has been increased and the chart surface has been expanded to four times its former area; at the same time, however, the mechanisms comprising the platter, lever, and counterbalance assemblies formerly carried on three distinct frames are folded up and nested together on one frame under one cover.

Lever Counterweight Is Eliminated

Redesign of the main lever has eliminated the heavy counterweight depicted by the old style lever to the left in *Fig.* 3. The new design is shown at the right. Designated *M* in *Fig.* 5, the main lever rests in a horizontal position. It will be noted that the elimination of the counterweight from the lever and the increased pivot

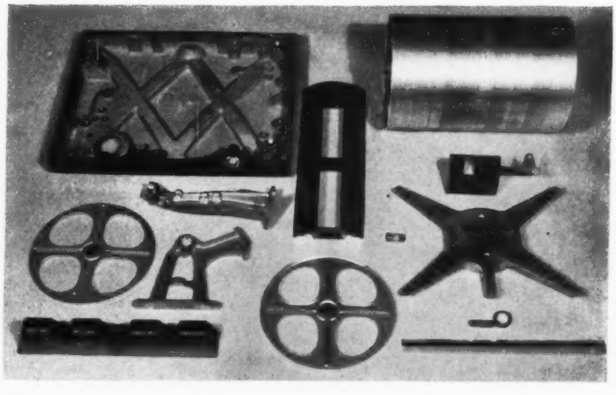


Fig. 4—*Important scale parts made of aluminum account to a large extent for reduction in weight. Scale base is in the upper left background and cylindrical computing chart at upper right*

distances are in harmony with good design. Fulcrum pivots are those at the lower end of the new lever as shown at the right of *Fig.* 3, while the load pivots are positioned midway between the fulcrum and the upper end of the lever which is connected to the nose iron *L* depicted in *Fig.* 5.

The lever spider arm *B* on which the platter rests is forked, one portion terminating at one

side of the main lever while the other section continues beneath the cylinder to the other side of the main lever. The load pivot *V* and bearing *U* which serve the shorter prong of the spider arm are shown in the left-hand drawing in *Fig.* 5. Numerals *S* and *T* in the right-hand drawing designate the main lever fulcrum pivot and bearing, respectively.

Agate bearings are employed, having V-shaped grooves in which rest the knife edges of the tool steel pivots. These pivots have ground shanks which are held in the main lever bosses by press fit.

Suspension of pendulum assembly *E* by stainless steel ribbons *P*, provides a full floating mechanism. When a load depressed the platter, this movement is imparted to the main lever and causes the lever nose *L* to pull downward the sector *X* through the steel ribbon *W*. Consequently sectors *Y*, (only one can be seen) climb up their respective guides *O*. A rack mounted at the axis of the rear sector meshes with a pinion on the shaft of the computing chart *A*, causing it to revolve with the vertical movement of the rack.

Check-Link Device Controls Shift

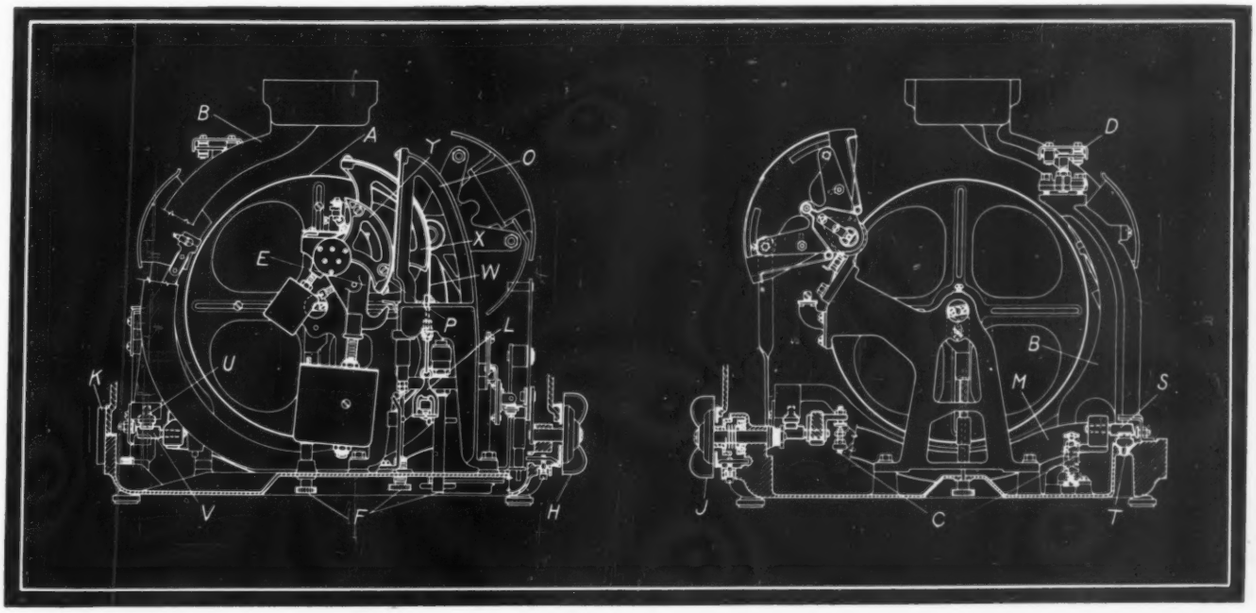
Another innovation is the knife-edge overhead check-link *D*. *Fig.* 5, which provides control of shift from loads on the edge of the platter, preventing any tendency for the lever spider arm *B* to tilt to either side. This check-link device consists of a series of steel bars in a parallelogram arrangement. One end of the assembly is held by a stud fixed in the lever spider arm and the other side is held to the upper portion of the scale frame. Steel block bearings imposed between the bars engage the knife edges of the cross-arms of the studs, allowing the bar assembly to move freely upward and downward with the scale arm, but preventing any appreciable side motion.

Main Lever Has Oil Dashpot

Thumb screws *F* lock the pendulum and the main lever, and lift the chart from its bearings when the scale is to be moved to another location. An oil dashpot which can be seen in *Fig.* 2, is positioned in the fork of the main lever, *Fig.* 3 right, to which it is connected to prevent excessive oscillation of the computing chart. Hold-down devices *C* which consist of cone pivots that engage circular thrust heads to provide "pin-point" contact retain the knife-edge pivots in the V-groove of the agate bearings.

With the weighing mechanism and its supporting structure now independent of the cover, it has been possible to make use of lighter metals. Previously, the application of a porcelain finish to the base and other parts of the weighing structure precluded the use of light metals such as aluminum as these would melt

Fig. 5—One of the numerous mechanical features of the scale mechanism is the pendulum assembly suspended by stainless steel ribbons to provide full floating characteristics. Agate bearings and tool steel knife edge pivots are employed. A built-in lighting system, controlled automatically as the scale goes into operation, illuminates both the customer's and merchant's dials



at a point well below the temperature necessary to fuse porcelain. The fourteen aluminum parts, *Fig.* 4, weigh 18 pounds, 33 per cent of the total weight of the scale. The larger parts such as the base, spider and chart brackets are sand castings, while for the smaller more intricate parts die castings are employed. One of the lightest and certainly the most interesting

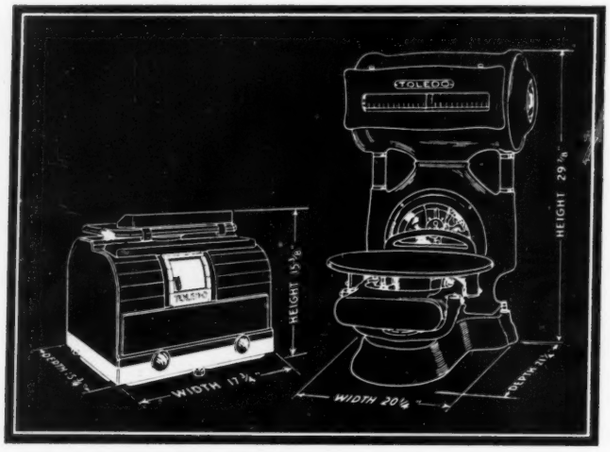


Fig. 6—Aside from reduction in size, the new scale at left weighs only fifty-five pounds as against one hundred and sixty-five pounds for the older model at right

parts is the chart, a thin aluminum sheet rolled into a cylinder and containing more than 95,000 figures. Because it is made of metal instead of paper as formerly, danger of distortion and inaccuracy is negligible and may be safely disregarded.

Numeral Capacity of Chart Doubled

The cylindrical chart, weighing only one-third of a pound, is so light that it readily comes to rest at the proper figure without swinging back and forth. One of the design problems in connection with this cylinder was the desirability of doubling the previous numeral capacity without reducing the legibility of the digets and intervals. In place of thirty prices per pound, sixty were desired, in penny graduations throughout. These penny graduations total 48,816.

To accomplish this purpose it was necessary to decrease the size of the figures on the new metal drum to half the previous size and then magnify them to their original size or greater to meet federal requirements. This meant that a lens assembly through which to read the price computing chart, would be necessary. In order to obtain the desired magnification without distortion or color fringes specially designed lenses are employed. A single lens made of common cylinder glass would have introduced defects in reading.

The new type lens is made up of optical glass with spherical curves on both sides. Of first importance in this lens is the correction of spherical aberration, a condition in which the rays from a single source fail to converge at the same focus. In the new lens the figures are seen as clearly through its margins as through its center.

Adjustment of Lens Assembly Provided

Approximately two-power magnification makes the numerals distinct from a distance of several feet. The scale is fitted with four lenses, 3 inches long by 1¾ inches wide, mounted in a rack covering the face of the cylinder. Through a control *H*, *Fig.* 5, the operator can shift the lens assembly from the lower to the upper price range of the duplex chart. Through the control handle *J* the lens assembly can be raised or lowered to bring it to the proper reading level for the operator's height.

In selecting a material for the cover, it became apparent that the desired results could not be obtained from materials then available. Porcelain applied to cast iron was the conventional finish for retail scales; however, it had certain limitations.

Search for a suitable cover material led to the study of plastics, and through a fellowship at Mellon Institute of Industrial Research a new urea-formaldehyde plastic was developed. Known as Plaskon, this new material now has found application far beyond the scale field. The molded cover of the scale, discussed on page 32 of the September issue of MACHINE DESIGN, is clamped to the base by metal disks *K*.

While the scale engineers were developing the new weighing mechanism the problem of external appearance was in the hands of Van Doren & Rideout, industrial designers. Since the outer walls of the scale were only a protective covering and had nothing to do with the weighing accuracy of the unit, they had a relatively free hand as to details of appearance.

Co-operative Research Scores

While there is an impressive transformation in the appearance of the new model over the old as illustrated in *Fig.* 6, the genuine significance of the accomplishment lies in the design methods, in the application of new materials, and in bringing to the foreground the possibilities of co-operative research of a number of specialized organizations toward the development of a single product. This procedure may suggest a formula for the successful redesign of many other products.

Scanning the Field . . . FOR IDEAS

DESIGN FOR PRODUCTION!

PROGRESS in welding practice is producing important design changes which offer fertile ideas that other engineers may profitably consider. One instance that has recently come to light is an ingenious method of eliminating machining in the production of a steering mechanism, *Fig.* 1. By the adoption of welding it now is possible to produce this part on a mass production scale at high speed and low cost, obtaining in addition maximum strength.

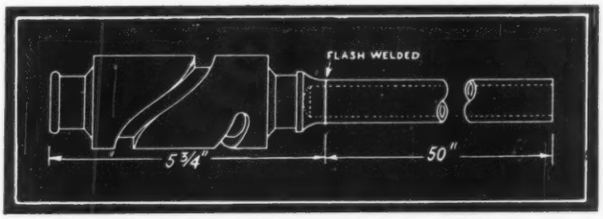


Fig. 1—*Welding eliminates machining in production of this automobile steering shaft*

The cam which operates the steering knuckles and drag links is turned out of a piece of steel not much longer than the finished length of 5¾ inches. To complete the assembly, the steering shaft is cut to length, about 50 inches, from tube stock 0.885 inch in diameter. Then the cams and shafts are welded together in a Thomson-Gibb automatic flash welder at the rate of 200 per hour. This method is said to produce a shaft that is actually stronger than one turned at higher cost from a single piece of material.

UTILIZING HYDRAULIC PRESSURE

TO CITE another instance where the automotive industry has shown its ability to make the most of mechanical prowess, take the new Chevrolet. Its engineers have devised a stop-lamp switch that is a compact unit with only one moving part, a metal diaphragm, which is depressed by hydraulic pressure when the brakes are applied. The diaphragm closes the circuit and lights the stop lamp. And speaking of brakes, these hydraulically-operated mechanisms have but one adjustment for each shoe. As the brake lining gradually wears down, full braking effect is maintained by turning a notched adjusting wheel inside the drum.

MEASURING THROUGH GEARING

ACCURATE measurement of products such as ribbons and cloth being wound on reels usually introduces complications as the diameters of the reels are constantly changing. This problem was overcome in typewriter ribbon machinery of Tybon Corp. by the use of a one-tooth gear, and accurate, positive measurement

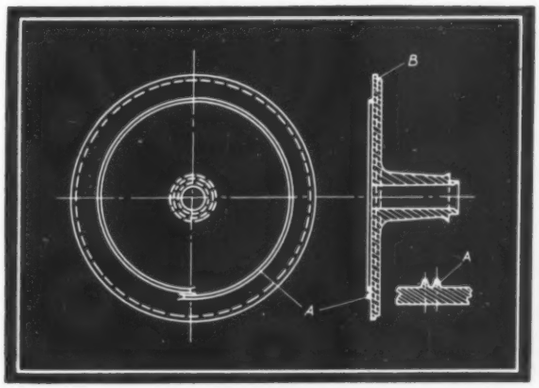


Fig. 2—*A one-tooth spiral gear is employed in device for measuring typewriter ribbon*

of ribbon lengths was achieved. In the design a zinc die cast part such as shown in *Fig.* 2, is employed, on which a pressed hub is spun at point *B*. The ribbon in the machine runs over this hub to the reel. Starting with this known size of hub, the problem of securing exact lengths is greatly simplified, as a definite number of rotations of the hub as brought about by the friction drive of the ribbon indicates the length of ribbon on the delivery reel.

Cast on the face of the wheel in *Fig.* 2 is a one-tooth spiral gear, shown at *A*. This gear mates with a stamped spur gear, and one revolution of the wheel advances the spur gear one tooth. A punched piece on this gear protrudes, and when the gear has made one complete revolution this piece contacts a spring hammer which rings a bell, thus informing the operator that the correct length of ribbon is on the delivery reel. In this way what might have become a serious problem of measurement is considerably simplified without sacrifice of accuracy.

GETTING AWAY FROM TRADITION

TELESCOPING sleeves protect the bearing surfaces of a slide bar employed in the suspended-wheel slide design that features the Bryant internal and face grinding machines.

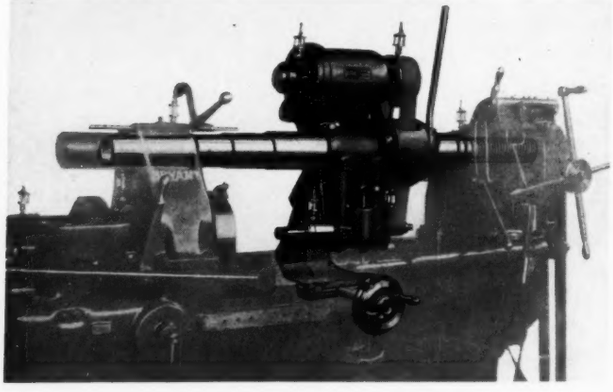


Fig. 3—*By the use of telescoping sleeves the bearing surfaces of grinder wheel slide are protected*

This construction, *Fig.* 3, also permits the use of pressure lubrication for the slide bar bearings with a totally enclosed arrangement. By placing the slide bearings above the coolant and grit, maintenance expense is reduced. Moreover, the idea presents decided advantages in wheel control as it involves the use of one slide only.

As the bar by which the wheel slide is suspended reciprocates, the sleeves telescope together. The grinding wheel is midway between the cross feed screw and the axis of the wheel slide bar. Thus 0.002-inch at the cross feed gives only 0.001-inch movement at the work, insuring greater accuracy. Also, one pound of pressure on the feed screw gives two pounds of pressure at the grinding wheel. The counterbalanced wheel slide takes up the backlash of the cross screw, and sizing to the closest limits thus is simplified.

Fig. 4—*Herringbone arrangement of conveyor rollers retards descent of material*

VARIATIONS IN CONVEYOR DESIGN

THREE ideas now prominent in conveyor design are impressive because of their simplicity. One is a gravity herringbone type unit, *Fig.* 4, employed by Westinghouse. The arrangement of the rollers retards the sharp descent of material to protect it against breakage. Moreover, the herringbone design prevents the package from running off the side of the incline.

The second unique idea makes use of continuous hollow rubber curbs which are vulcanized to the sides of any standard conveying belt. The

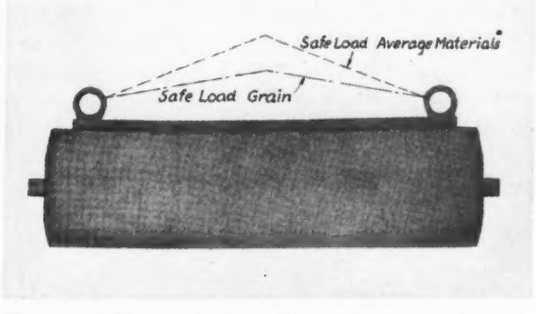


Fig. 5—*Hollow rubber curbs on conveyor belt aid function of materials handling system*

function of these curbs, as shown in *Fig.* 5, is to prevent materials falling off of the belt while being loaded and conveyed. Being hollow and elastic, the curbs bend freely around all pulleys in either direction without setting up stresses in the belt itself. This type of conveyor system was developed by Curbelt Co. Ltd., Montreal.

As a third method, the runaround Redler conveyor, *Fig.* 6, furnishes a means of transporting bulk material, by adhesion in the materials themselves, in several directions or around horizontal curves, with discharge at any point. The principle employs a series of skeleton flights closely spaced an a light chain, which carries such materials as grain, coal, salt, starch, etc. en masse. With this system the necessity for accurate feed control is eliminated; that material which is not deliverable to a processing machine through outlet ports is returned to the feed point. Stephens-Adamson Mfg. Co. builds the unit.

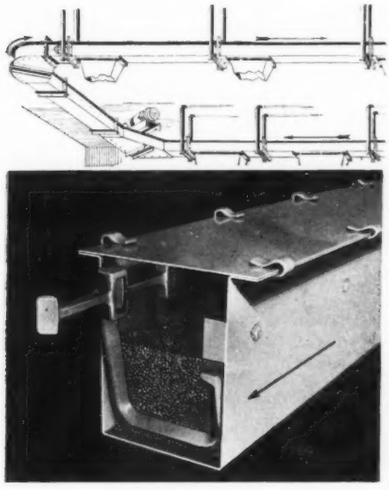


Fig. 6 — Skeleton flights carried by a chain transport materials such as grain, salt, starch, etc., around horizontal curves

SUCTION ASSISTS CLEANING OPERATION

THERE is always another way of doing the same thing. Take the new type of windshield wiper, *Fig.* 7, which makes use of soft carbon-base rubber with a hollow perforated tube running its length. Ten flexible wiping ribs create alternate areas of pressure and suction with the stroke, drawing water into the hollow tube through the perforations. The self-cleaning operation prevents the same water from being smeared back and forth across the windshield. With this balloon construction, the new blade will hug even a warped glass and wipe it clean. Another feature is the fact that an ordinary pipe cleaner dipped in glycerine and placed inside the hollow tube will provide a glycerine film on the windshield for several hours, effectively removing sleet and preventing ice from forming on the glass. Moreover, the design makes use of stainless steel for all metal parts. Rex-Hide Inc. developed the device.

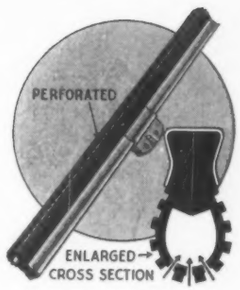


Fig. 7—Ten flexible wiping ribs facilitate cleaning operation of windshield wiper. A hollow perforated tube receives the water

IMPACT CONNECTS CAR CIRCUITS

AGAIN the designer scores, this time in eliminating noisy, jerking trains that have long been the nemesis of the traveler. A new railcar coupler and train line connector by which all air, steam and electrical connections are made automatically upon impact are shown as a complete unit in *Fig.* 8. Think what this means to brakemen from a safety standpoint! By using air cylinders and a valve in the cab, the uncoupling operation can be performed by the locomotive engineer. Moreover, the device, developed by Ohio Brass Co., Mansfield, O., is designed to provide rigidity between cars, and thus prevent surging, buckling and impact blows.

The steam line is divided immediately back of the trainline connector, making two steam connections on the face of the unit. This is done to provide male and female connections, permitting cars to be turned end-for-end in make-up of the train. Check valves within the steam connections automatically close ports upon uncoupling. Electric contacts provide circuits from car to car for signaling purposes and to make connections between cars for air conditioning, lighting and telephones.

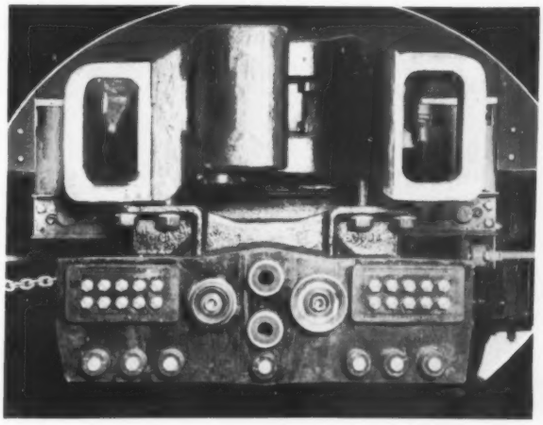


Fig. 8—All air, steam and electrical connections are made upon impact of railcars

Synthetic Rubbers Resist Oil,

By Allen F. Clark

CHEMICAL engineers, together with their brethren in metallurgical fields, have done more to reform our industrial concepts than any other group of individuals. Their achievements affect every detail of our daily lives, but their greatest contribution to industry is in the development of improved materials, and progress in materials is synonymous with design progress. Each depends on the other, many machines being impossible of conception without the notable advances in materials composition, while advances in machinery permit the production of improved materials.

Such continuous development has made this a synthetic age. Even today's irons and steels are synthetic, as they are carefully compounded metallurgical achievements which have only basic similarity with the parent metal. However, the real indication of the trend is the creation of entirely unique substances, materials built up to secure compositions with completely new characteristics. These new developments are entirely different from anything found in a natural state, although their properties may be similar. Examples include the urea and phenolic resinoids, and the new synthetic rubbers discussed in the following which, though possessing rubber-like properties, have no rubber in them.

Disregarding, for the moment, applications of these synthetic rubbers and the reasons for their use, there are two recent developments that make a discussion of these materials exceedingly timely. The first of these is the *Chemical and Metallurgical Engineering* award for "Chemical Engineering Achievement" made to the company which, through the use of chemical engineering in any phase of its activity, has contributed the most meritorious advance to the industry. This award was made for the development and production of synthetic rubber, known as DuPrene, and a variety of other essential organic chemicals. The second recent event is the completion of a plant started in the depths of a depression, which for the first time makes synthetic rubber available to the extent of 1,000,000 pounds each year. An indication of the necessary reliance of each branch of industry on the others is found in the fact that this production would have been impossible had it not been for the comparatively recent development of certain corrosion resistant alloys and

Fig. 1—Left—Composition diaphragm fits this valve to the handling of acid and alkaline compounds

Fig. 2 — Left — Molded parts are employed in oil well packers and similar parts

Heat and Acids

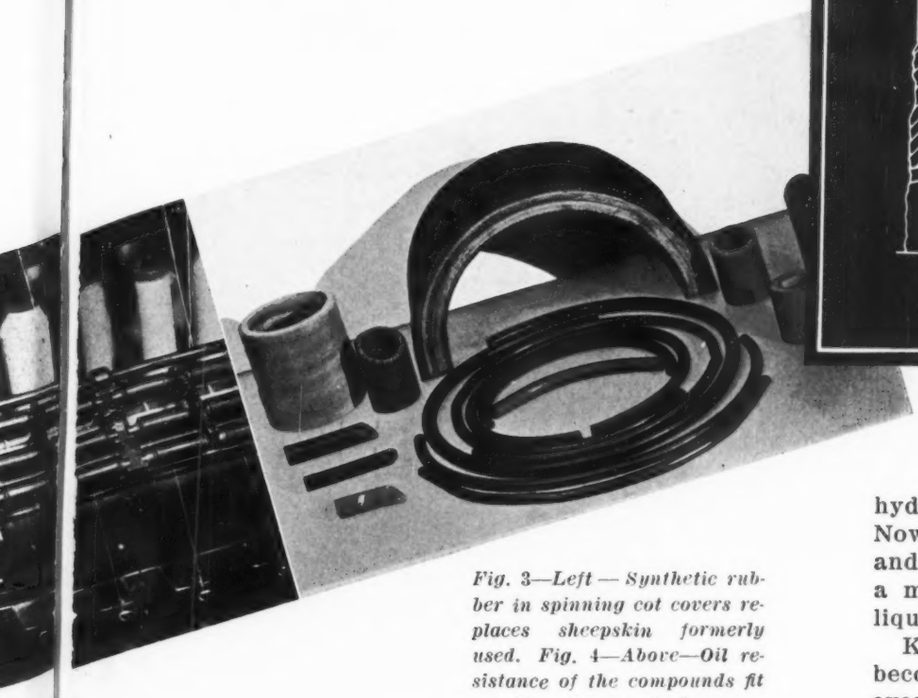


Fig. 3—Left — Synthetic rubber in spinning cot covers replaces sheepskin formerly used. Fig. 4—Above—Oil resistance of the compounds fit them for use in hose

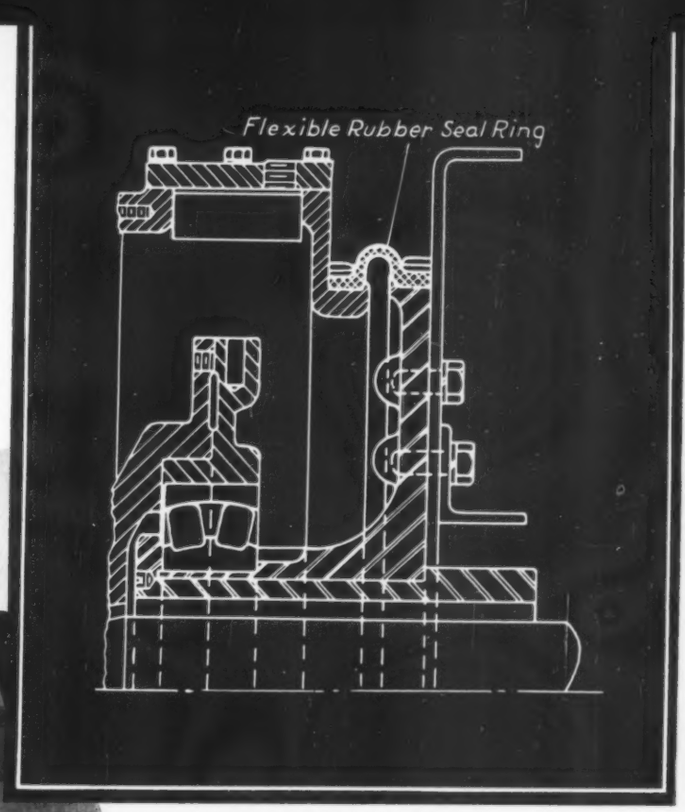


Fig. 5—Seal ring is subjected to a twisting vibratory motion and action of oils

improved glass-lined manufacturing equipment.

Inasmuch as DuPrene is an entirely new product and has numerous uses in machinery, engineers will no doubt be interested in the process by which it is manufactured by E. I. du-Pont de Nemours & Co. Broadly stated, the material is made from ordinary acetylene gas such as that used a generation ago in our bicycle lanterns and in Prestolite lamps for the first automobiles. Summarizing the process, the first step in the manufacture is the obtaining of acetylene from calcium carbide. Next, acetylene is converted into mono vinyl acetylene.

When converting acetylene into mono vinyl acetylene considerable of the acetylene remains unchanged while part is converted into other gases. The problem is to separate the mono vinyl acetylene from the other gases. This is done by cooling to about minus 100 degrees Fahr. (a step made possible by very low temperature refrigerating machinery). At the same time, these gases are subjected to pressure to make them liquid. The liquid gases are slowly warmed and distilled by fractional distillation to separate into various fractions.

In this way pure mono vinyl acetylene is obtained. It is then warmed and mixed with hydrogen chloride and exposed to a catalyst. Now one molecule each of mono vinyl acetylene and hydrogen chloride join together, making a molecule of chloroprene. This is a volatile liquid, clear and water-white, and is unstable.

Kept in sealed glass-lined vessels, the liquid becomes viscous and shrinks. The weight, however, remains. The molecules get closer together (polymerize). It gives off heat. About one-half changes to DuPrene.

Thus is developed what might be called a chloroprene rubber. Although this material is NOT a synthetic duplication of rubber, nor it it even chemically the same as rubber, it can safely be termed a development inside of the rubber industry as DuPrene is a rubber-like material. Further, it is an advance in rubber development as it answers the needs of a great many machine applications of considerable complexity brought out by the increasing ingenuity of inventors and the engineering alertness displayed by these inventors in perfecting continuously improved machinery.

Is Available in All Forms

This new engineering material is available in all forms from sponge rubber to hard rubber. It may be molded, rolled, impregnated, laminated or combined in any other form. Each composition as made by various manufacturers contains other ingredients in addition to DuPrene, the kind and amount varying widely, depending upon the conditions of service for which the part is designed. The compositions are vulcanized with the same equipment employed in processing what might be called

natural rubber, although there is an essential difference—in the vulcanization of DuPrene compositions no sulphur is required.

Compositions of this material resemble natural rubber in strength, toughness and elasticity, but there the similarity ends. Of exceptional value to the machine designer is the ability of the synthetic compounds to resist the deteriorating effects of gasoline and oils of all types. Also, the vulcanized product is more resistant to oxidation, thus does not age rapidly, and withstands the action of sunlight better than the natural product. This resistance

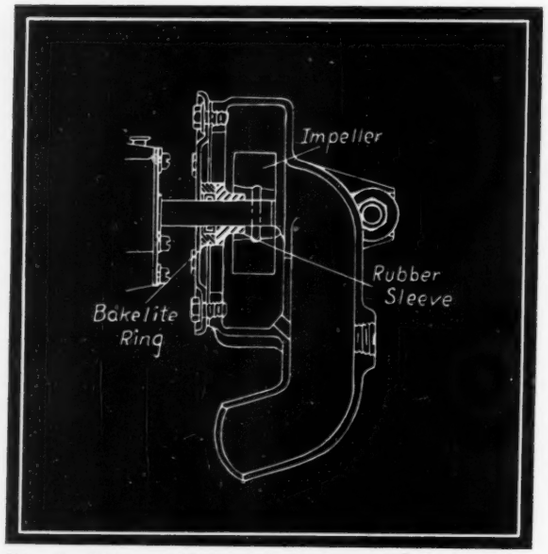


Fig. 6—This packless water pump makes use of a synthetic rubber sleeve which maintains contact

to oxidation and to flex-cracking makes possible the use of the product in manifold places where the elasticity of rubber is required, but where, due to conditions of exposure, the material could not be used previously.

The synthetic compounds will withstand temperatures of about 200 to 325 degrees Fahr., depending upon the composition, become harder at high temperatures, and do not support combustion. They will resist the action of alkalies and the oxidating types of acids. Another characteristic is the ability of cements of the compounds to impregnate porous bodies. Also, DuPrene compositions are less permeable to gases than the natural compounds.

Considering these unusual properties, it can be understood that synthetic rubber has opened up new markets for mechanical rubber goods to a greater extent than it has replaced natural rubber because it will stand up under conditions which have never permitted the use of natural rubber. Consequently, it has made possible the redesign of many types of machinery, motors, compressors and other industrial appliances.

Skipping over the field of applications before considering individual cases, it is found that the petroleum industry has become an important user of the compositions as inner liners for tubes in oil and gasoline ship loading hose, gasoline hose of all types and tubing, *Fig.* 4, packer rubber and pump pistons, *Fig.* 2, and gaskets and packings.

The automobile industry has adopted the material as a protective coating for ignition wires and for many rubber parts other than tires where heat and oil are encountered. An interesting application in this field is the use of a DuPrene composition for the brake bellows on hydraulic brakes. In ignition cable the lacquered braid is adversely affected by corona effect. Here the composition is used as a protective jacket over natural rubber insulation, overcoming this difficulty.

Rolls Do Not Absorb Ink

The printing trade uses large quantities of the material in printing rollers. In these applications rolls of synthetic rubber do not absorb inks, and thus enable the production of better color printing, as the inks used in each operation are not discolored by previous printings. Aviation has adopted it for refueling hose and tank seals and for flexible oil line connections. In hose installations, an advantage of the use of the synthetic compounds lies in the fact that no liner of the metallic type is necessary. The smooth bore afforded by the compositions considerably facilitates delivery. Wire insertions aid in achieving strength.

In the manufacture of gaskets, packings, valve diaphragms, pump pistons, brake cups, vibration dampening pads (of sponge rubber) and sealing rings, the ability of the material to resist oils of all types is the principle factor. A further development in the compounding is the use of DuPrene with cork to secure a product known as Corprene which is being manufactured by Armstrong Cork Products Co. Some of the parts made from this composition are shown in *Fig.* 7.

Material Compresses Uniformly

When cork is compressed, the major change in dimension is in the direction of the force applied. In the case of a plastic material like rubber or DuPrene the change in dimension, when force is applied, is in all directions. Corprene compounds are DuPrene compounds to which various quantities and types of cork have been added. The result of the addition of cork is to lessen the all-dimensional flow or, in other words, to make the material compressible.

When the surface of Corprene is sanded, a high coefficient of friction is presented by the exposed surface. This characteristic is of special advantage in making feed and friction

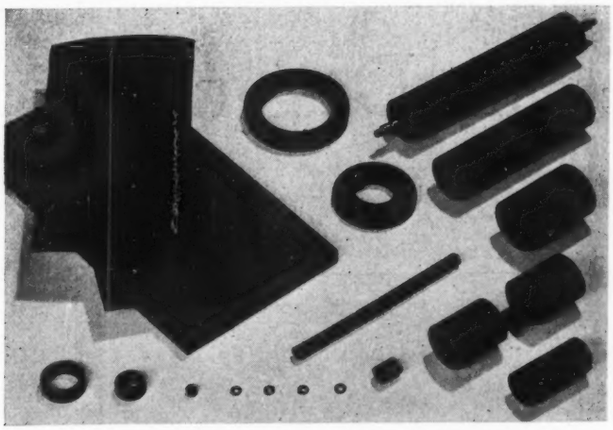


Fig. 7—Cork may be compounded with synthetic rubber to give parts suitable for friction driving

rolls for handling oily or greasy materials. Uses of this material include poppet valve disks for oils and fuels, valve packing, transformer gaskets, carburetor gaskets, gaskets for magnesium alloy parts, nonskid wing walks for airplanes and many other applications. An advantage of gaskets made from this type of composition is that they do not crumble upon removal, but may be replaced with assurance of continued service.

Because the synthetic rubber compounds in the usual compositions are elastic and impervious to alcohol, antifreeze solutions and radiator cleaning compounds, their application to a packless water pump was made possible. In the pump, shown in *Fig.* 6, a ring around the pump driveshaft seated against the inner surface of the pump cover plate is locked in position by a pin through the pump shaft and is held tightly against the cover plate by a molded composition sleeve which is under constant stress. In this application the composition replaces a metal spring formerly required because of the liquids which must be handled.

Withstands Vibratory Motion

Not only oils, but twisting vibratory motion must be withstood by the part shown in *Fig.* 5. In this machine, a materials screen, the portion at the left remains stationary while that at the right rotates through a small radius. As splash lubrication was used and absolute sealing was required, the seal had to be firmly attached to both sides, be flexible, and resist oil.

Materials employed in the unit seal of Rotary Seal Co., *Fig.* 8, must form a flexible joint between seal ring and shaft, drive the complete seal assembly frictionally and seal against leakage along the shaft. Here again DuPrene compounds have been found to be of advantage in giving the resiliency and flexibility necessary for the purpose. The style shown, one of three, is one in which both ends of the stuffing box are sealed and lubrication is supplied from a grease or oil cup.

Ability of the compounds to withstand heat and their property of impregnating porous bodies easily has fitted them for use in V-belts, transmission belting and conveyor belting as well as diaphragms of all types. As used in a valve disk, the composition replaces an oil-filled fabric. In a glass spinning disk which holds the glass while a flame plays on it, the synthetic materials have demonstrated resistance to exposure to flame.

An interesting application of a diaphragm is in the Hills-McCanna valve of *Fig.* 1. The operating principle of the Saunders patented valve is the compressing of the diaphragm between two metal surfaces. As shown, the valve is open. Diaphragms are made of a variety of reinforced resilient compositions, making it possible to employ the valve for handling alkalis,

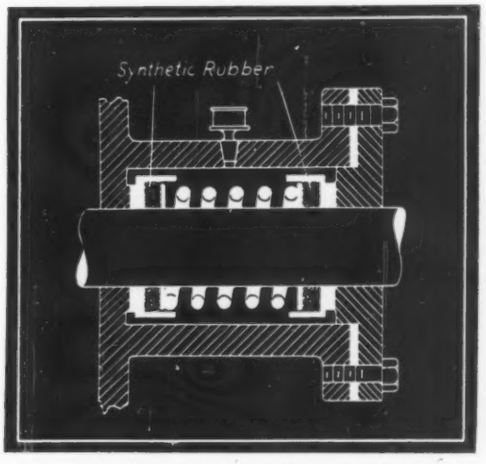


Fig. 8—In rotary seals, packings must maintain tight fit and not deteriorate easily

acids, fruit juices, alcohol, gases, canning stocks, liquids with solids in suspension, petroleum products, hot or cold water, chlorine solutions and many solvents.

Another application where DuPrene compositions are called upon to resist chemical action as well as wear is in the spinning cot covers shown in *Fig.* 3. These covers as used on a textile machine replace the former design which employed sheepskin, the only previous material which would withstand the forces present.

These comparatively few applications serve to indicate the possible field for this new machine material. It is a further step in the continuous effort to secure better and still better materials. Working hand in hand, with each ever alert to take advantage of the other's developments, the designer and the chemical engineer can push developments far beyond what are now accepted as the definite limits of progress.

Analyzing Fallacies in Design of Press Frames

By S. D. Brootzkoos
Consulting Engineer

COMPARATIVE advantages of one piece, with or without tie rods, and of built-up frame constructions in rolling mills and heavy power presses or shears are subject to persistent controversy among machine designers, builders and users of these machines.

In the case of machines with one-piece frames, as used in rolling mills and coining presses, statements are often heard that the insertion of heavy tie rods under an initial tension in their housings insures these frames against springiness under the working load.

In the case of machines with built-up frames, as used in heavy power presses and shears in which the bed (table), two uprights (stands) and crown are held together by steel tie rods, it is often claimed that such frames are stronger more rigid and less breakable than the one-piece solid cast frames.

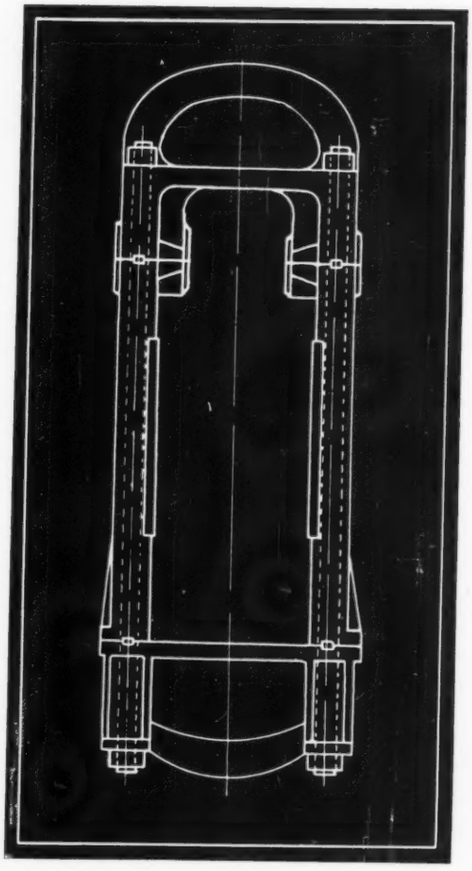


Fig. 1—Built-up tie rod frames such as this require careful analysis

All Materials Elastic

The foregoing fallacies are not due exclusively to the exuberant enthusiasm or salesmanship of the designers and builders of the particular machines, but can be traced to a somewhat confused and erroneous application by them of the theory of tie rods which are mere bolts working under stress, load and shock conditions. The principal cause of these misstatements lies in the presumption that of all the frame parts of rolling mills or presses the rods alone are the elastic elements. But since all materials entering into construction of any machine are elastic bodies, their characteristics have also to be taken into consideration when designing and presenting the advantages of the use of the tie rods in the construction of the machine. As all elastic materials follow Hooke's Law, it is an easy matter to dispose of the fallacies.

Fig. 2 shows an outline of one-piece solid rolling mill housing and *Fig.* 1 a built-up tie rod frame press.

The problems before us are: (1) Will the placing of the tie rods in the one-piece solid housings of rolling mills or presses increase their rigidity; and (2) are built-up tie rod machine frames *always* more advantageous than the one-piece solid frames?

In the following discussion we shall omit all frames with more than two tie rods in any stand or upright, considering a multiplicity of tie rods as being a mere encumbrance of the frame construction, nor shall we consider frames where the crown alone is cast separately and is held in place by short bolts locked or keyed in the frame.

Furthermore, we will presume that the upper (crown) and the lower (bed) parts of the frames are designed and constructed as rigidly as engineering science knows how to do it. The placing of the tie rods in one-piece frames is thus

intended for diminishing any possible stretch or spring in the uprights or stands, and in the built-up frames for taking up unyieldingly all working loads while holding rigidly together all component parts of the frame.

In this connection we shall consider exclusively the case when the working load in the machine is below (less) than the total tension stress (preload) built up in the tie rods by tightening them in the assembling operation. If the working load were to be more than the total tension stress built up in the tie rods, then there would be no advantage in placing them in the one-piece solid frames unless the material of the tie rods were stronger than that in the frame. Under the latter condition the tie rods in the built-up frames will cease to hold together all component parts of the frame with the result that the uprights will start to wabble, the slide will lose its proper guidance, the gears will not mesh properly, etc.

For the convenience of our further discussion we shall use the following symbols for presenting different factors:

S_o = mean cross sectional area of an upright in a one-piece, without tie rods, frame

S_t = same in a tie rod frame

S_r = cross sectional area of a tie rod

E_o = modulus of elasticity of the material in a one-piece, without tie rods, frame

E_t = same in the uprights of a tie rod frame

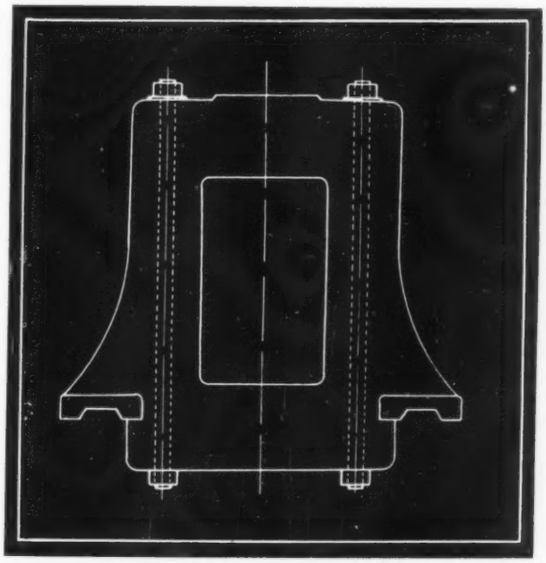


Fig. 2—Placing of tie rods in one-piece cast iron housings will increase their rigidity

E_r = same of the tie rods

L_o = height of the upright (stands) in a one-piece frame

L_t = same in a tie rod frame

L_r = length of the tie rods

D_o = elongation (stretch or spring) of the stands under a working load in a one-piece frame

D_t = same in a tie-rod frame

W = working load

In a one-piece, without tie rods, machine frame the working load W will be taken up by the stands (uprights) each of which under its load of $W/2$ will stretch, in accordance with the Hooke's Law, for an amount.

$$D_o = \frac{W}{2} \times \frac{L_o}{S_o E_o} \quad \text{.....(1)}$$

In the frames with tie rods of either one-piece or built-up type the effect of the working load will be to relieve the compression in the stands (uprights) and to increase the tension in the tie rods.

Let us assume that:

W_t = the part of the working load W which will tend to decrease the compression in the stands (uprights), and

W_r = the part of the working load W which will tend to increase the tension in the tie rods

and that

$$W = W_t + W_r$$

For each stand (upright) its part of the working load would be $W_t/2$ and for each tie rod $W_r/4$.

Under our presumption that neither the crown nor the beds of the machine frames spring under the working loads we must have it that the amount of the relief from compression, i.e., the elongation of each of the stands (uprights) under its load $W_t/2$ is equal to the elongation of each tie rod under its load of $W_r/4$, and both identical with D_t.

In acordance with Hooke's Law the elongation in each upright would be

$$D_t = \frac{W_t}{2} \times \frac{L_t}{S_t E_t}$$

and same in each tie rod

$$D_t = \frac{W_r}{4} \times \frac{L_r}{S_r E_r}$$

Presenting the foregoing formulas as

$$W_t = \frac{2 S_t E_t D_t}{L_t}$$

$$W_r = \frac{4 S_r E_r D_t}{L_r}$$

and adding them together we will get

$$W = W_t + W_r = \frac{2 D_t}{L_t L_r} (S_t L_r E_t + 2 S_r L_t E_r) \text{ or that}$$

$$D_t = \frac{W}{2} \times \frac{L_t L_r}{S_t L_r E_t + 2 S_r L_t E_r} \quad \text{.....(2)}$$

Formula (2) gives the amount of the stretch or spring in any tie rod, one-piece or built-up, machine frame provided the working loads are below the total tension stress in the tie rods built up in them in the assembling operation. Formulas (1) and (2) give the most correct

and easy method for comparing the advantages of different constructions of frames for rolling mills and presses under identical conditions.

Namely if:

I. $D_o < D_t$ or $\frac{D_o}{D_t} < 1$

it would mean that a one-piece, without tie rods, frame stretches less and is more rigid than a tie rod frame. The one-piece frame is, therefore, preferable.

II. $D_o = D_t$ or $\frac{D_o}{D_t} = 1$

it would mean that either frame construction, with or without tie rods, stretches for the same amount and that both constructions are equally good;

III. $D_o > D_t$ or $\frac{D_o}{D_t} > 1$

it would mean that a one-piece, without tie rods, frame stretches more than a tie rod frame. The tie rod frame construction is then preferable.

We shall now compare one-piece frames WITH and WITHOUT tie rods in their stands or uprights.

In accordance with formula (1), a one-piece, without tie rods, frame under a working load W will stretch for an amount

$$D_o = \frac{W}{2} \times \frac{L_o}{S_o E_o}$$

An identical frame but with inserted tie rods under the same load W will stretch, in accordance with formula (2) after substituting $S_t = S_o - 2\,S_r$; $L_t = L_o$; $E_t = E_o$, for an amount

$$D_t = \frac{W}{2} \times \frac{L_o L_r}{(S_o - 2\,S_r)E_o L_r + 2\,S_t E_r L_o}$$

In order to ascertain the advantages of either frame construction we shall take their ratio which is

$$\frac{D_o}{D_t} = 1 + \frac{2\,S_r}{S_o}\left(\frac{E_r L_o}{E_o L_r} - 1\right) \qquad \text{.....(3)}$$

Since in the foregoing formula

$$\frac{1}{4} < \frac{S_r}{S_o} < \frac{1}{2} \div \frac{3}{4}$$

$$\frac{1}{2} < \frac{L_o}{L_r} < 1$$

the advantages of the constructions under the comparison depend exclusively upon the value of $[(E_r L_o/E_o L_r) - 1]$ i.e. upon the moduli of elasticity of the materials used in the frames and the tie rods.

When cast iron frames with and without tie rods are compared we shall have:

$E_o = 15{,}000{,}000$ lb./sq. in.

$E_r = 30{,}000{,}000$ lb./sq. in.

$$\left(\frac{E_r L_o}{E_o L_r} - 1\right) > 0$$

and consequently

$$\frac{D_o}{D_t} > 1$$

which means

One-piece solid, without tie rods, cast iron frames for rolling mills or coining presses stretch (spring) more than similar frames with inserted steel tie rods.

When steel frames with and without steel tie rods are being compared we have

$E_o = E_r = 30{,}000{,}000$ lb./sq. in.

$$\left(\frac{E_r L_o}{E_o L_r} - 1\right) < 0$$

and consequently

$$\frac{D_r}{D_t} < 1$$

which means that

One-piece solid, without tie rods, steel frames for rolling mills and coining presses stretch (spring) less than similar frames with inserted steel tie rods.

In other words

The placing of steel tie rods in one-piece frames for rolling mills and coining presses is advantageous only in machines with cast iron frames.

The placing of steel tie rods in one-piece cast steel frames, which is quite often done, does not increase their rigidity unless they are placed to fill out cored spaces in the stands or uprights provided for preventing the formation of shrinkage cavities, pipes, etc.

We shall now discuss the advantages of either built-up tie rod frames over one-piece frames

Conditions for a Preferable Frame Construction in Power Presses of a Conventional Design

Case	Type of Press Frames Under Comparison		The Conditions for a Preferable Press Frame Construction		
	One-Piece, Without Tie Rods, Frame	Built-up Tie Rod Frame	$D_o/D_t < 1$ One piece frame preferable	$D_o/D_t = 1$ Either type frame equally good	$D_o/D_t > 1$ Tie rod frame preferable
A	with cast iron frame	with cast iron frame	$S_o > 10.8\,S_r$	$S_o = 10.8\,S_r$	$S_o < 10.8\,S_r$
B	with steel frame	with cast iron frame	$S_o > 5.4\,S_r$	$S_o = 5.4\,S_r$	$S_o < 5.4\,S_r$
C	with steel frame	with steel frame	$S_o > 9.4\,S_r$	$S_o = 9.4\,S_r$	$S_o < 9.4\,S_r$

This table shows plainly that the advantages of either one-piece or tie rod frames depend upon the cross sectional areas of the uprights and the tie rods of the machines which are being compared.

or vice versa.

By using the same fundamental formulas (1) and (2) and taking their ratio we shall obtain

$$\frac{D_o}{D_t} = \frac{L_o(S_t E_t L_r + 2 S_r E_r L_t)}{S_o E_o L_t L_r} \quad \ldots\ldots (4)$$

To simplify this formula let us assume

$$L_o = L_t = m\, L_r \text{ and } S_t = n\, S_r$$

then

$$\frac{D_o}{D_t} = \frac{S_r}{S_o}\left(n\,\frac{E_t}{E_o} + 2\,m\,\frac{E_r}{E_o}\right)$$

In order to find the advantages of either construction we shall consider the following three general cases:

A.—One-piece solid cast iron frame versus built-up tie rod cast iron frame.

With $E_o = E_t = 15{,}000{,}000$ lb./sq. in. and $E_r = 30{,}000{,}000$ lb./sq. in. we will have

$$\frac{D_o}{D_t} = \frac{S_r}{S_o}(n + 4\,m)$$

B.—One-piece cast steel frame versus built-up tie rod cast iron frame.

With $E_o = E_r = 30{,}000{,}000$ lb./sq. in. and $E_t = 15{,}000{,}000$ lb./sq. in. we will have

$$\frac{D_o}{D_t} = \frac{S_r}{S_o}(\tfrac{1}{2}\,n + 2\,m)$$

C.—One-piece cast steel frame versus built-up tie rod cast steel frame.

With $E_o = E_t = E_r = 30{,}000{,}000$ lb./sq. in. we will have

$$\frac{D_o}{D_t} = \frac{S_r}{S_o}(n + 2\,m)$$

Since in the foregoing formulas $S_r/S_o < 1$ then the value of the ratio D_o/D_t or the advantages of either type of frame construction, depend upon the values of the coefficients "m" and "n", or in other words, upon the size of the tension members in the frames of the machines under comparison.

The built-up tie rod construction of frames is mostly used in heavy power presses and shears. The coefficients "m" and "n" are usually (taken from the actual practice):

$$m = 0.7 \text{ and } n = 8$$

We will have then:

Case: A.

$$\frac{D_o}{D_t} = 10.8\,\frac{S_r}{S_o}$$

Case: B.

$$\frac{D_o}{D_t} = 5.4\,\frac{S_r}{S_o}$$

Case: C.

$$\frac{D_o}{D_t} = 9.4\,\frac{S_r}{S_o}$$

In order to show more evidently and conclusively the conditions for the advantages of the respective frame constructions we shall present the foregoing formulas in table form, as shown in the accompanying compilation.

Assets to a Bookcase

Symposium on Welding of Iron and Steel

Two volumes of 696 and 984 pages, respectively; published by the Iron and Steel Institute, London; available through MACHINE DESIGN, *Cleveland, for $11.00 postpaid and in Europe through the Penton Publishing Co. Ltd., Caxton House, Westminster, London.*

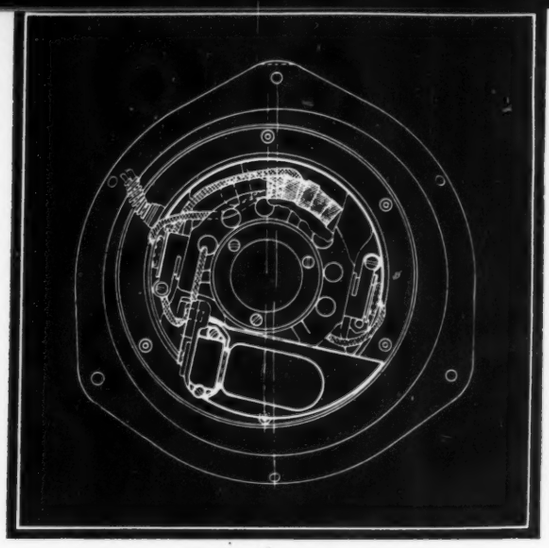
THESE two volumes constitute the proceedings of a symposium on welding of iron and steel organized by the Iron and Steel institute in co-operation with a number of other technical societies and conducted on May 2-3, 1935, during the institute's annual meeting in London. The symposium was arranged upon suggestion of the British government which believed the subject of welding had not been studied sufficiently.

Object of the symposium was to review the position of welding in all its industrial aspects, both in Great Britain and other countries; to obtain knowledge of the problems encountered in welding; to reveal what research work has been or is being undertaken; and to consider the advisability of taking steps to co-ordinate research work and to stimulate and guide future research, possibly with a view to formulating a national scheme.

The printed volumes embrace about 150 technical papers divided into four main groups, specially written for the symposium and contributed by 15 technical societies including several foreign organizations. Each group is prefaced by a summary and is followed by a record of the verbal and written discussions on the papers, and the authors' replies to the comments. Group 1 is incorporated in Vol. I and groups 2, 3 and 4 in Vol. II.

Group 1 deals with present-day practice and problems of welding in engineering industries and is in turn broken down into two subgroups. Subgroup (a) is concerned with bridge and structural engineering; pressure vessels, including boilers, pipe lines, tubes, tanks, and vessels for use at high temperatures and pressures; railway material; and shipbuilding. Subgroup (b) is confined to the aeronautical; automobile; chain; electrical; heavy engineering and machinery manufacturing, including marine; iron

(*Concluded on Page* 56)



By Harold B. Veith

Make Lighting System

BECAUSE good lighting conserves human energy and thereby increases efficiency of operators of machines, it now has become the designer's responsibility to see that means for proper illumination are specified before his layout leaves the drawing board. That the trend is definitely in the direction of built-in lighting in the design of machinery is indicated by numerous new types of industrial, commercial and domestic equipment that has been introduced recently.

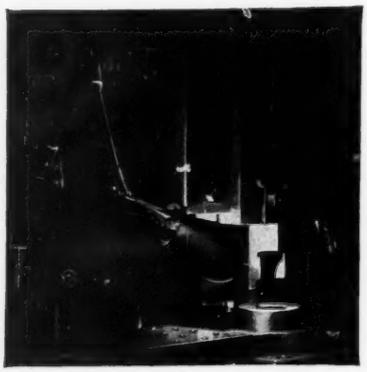


Fig. 1 — Flexibility, a desirable feature for machine lamp fixtures is obtained by employing two arms with ball and socket joints

The type of lighting equipment selected for a specific application obviously will depend on the machine and the nature of its functions. In some cases it is desirable to utilize a fixture capable of being adjusted to direct illumination on more than one spot at different intervals. To meet this requirement of flexibility, the Fostoria machine lamp, *Fig.* 1, employs two arms with ball and socket joints. The base arm is 11 inches long and the extension arm measures 10⅝ inches. By means of a glareless shade, uniform lighting of fifty-foot candles or more is focused on the point where it is needed. This light has been developed for builders of machines, whose choice in the matter of positioning the fixture where it most effectively will serve the operator is of course governed by an intimate knowledge of operating requirements.

Is Part of Cleaning Unit

Another type of built-in lighting is illustrated in *Fig.* 3, which shows how the lighting fixture is incorporated in the design of the new Hoover vacuum cleaner. In this case the problem is one of illuminating the pathway of the machine, and it obviously is unnecessary to employ a flexible unit. Other companies such as General Electric have also adopted this idea of furnishing the housewife with illumination that obviates the

Fig. 2—Obviously, the absence of an adequate lighting system on this machine handicaps the operator

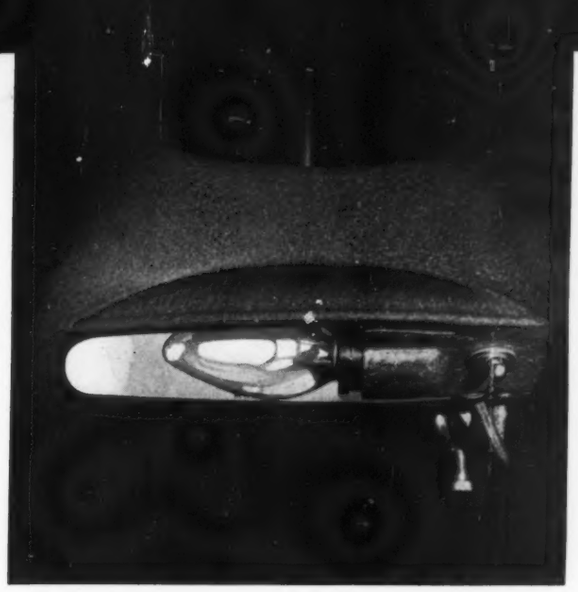


Fig. 3—Extreme Left—Lighting fixture is integral part of this vacuum cleaner mechanism. The same may be said for the light embodied in sewing machine arm depicted in Fig. 4 (adjacent)

Integral with Machine

strain of the extra concentration otherwise necessary in operating the unit.

Sewing machine designers also have become increasingly conscious of the advantage of a light directed on the work. Here again, the application lends itself to a more or less stationary arrangement, *Fig.* 4, which shows the housed-in sewing light on the White machine as an integral unit. A toggle switch is within easy access of the operator. Wiring is concealed and a pleasing appearance has been attained by the designer in providing a recess in the arm to accommodate the lamp.

Serves a Dual Purpose

In the case of the Trimson sander, *Fig.* 6, the reflector housing of the light serves as a hand rest when the floor handle is detached, and a hand grip substituted to adapt the unit for bench work. Light is flooded directly on the work in much the same manner as in the case of the vacuum cleaner.

The foregoing are impressive examples of the progress that built-in lighting has made. However, there are many designers who still are skeptical of its value. No better picture dramatizes the importance of proper and adequate illumination than *Fig.* 2. Before application of local lighting to a duplicating machine it was difficult for the operator, in placing the master on the roll, to see the imprint on the gelatin and assure himself that it was clear of any previous duplicating, cuts or lakes. Moreover, loss of time resulted in cases where blocking out on the gelatin was required due to the fact that the

Fig. 5—Study lamp type of unit furnishes approximately 60 foot-candles of illumination on the work

The same machine depicted in Fig. 2 with lighting installed. Observe advantage of proper illumination

working surface was obscured. One glance at the position of the operator in the left-hand view will reveal how fatiguing his working positions must have been. After the installation of lights as shown in the right-hand view he was able to abandon acrobatics and pursue his work without difficulty. It is obvious that better work and increased production resulted.

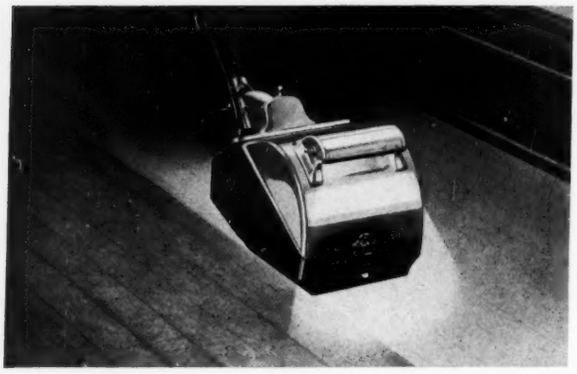


Fig. 6—Flood of light is projected in path of sander, thus enabling operator to perform better work

That is just one instance where improved lighting proved beneficial. Another is the combined light and record holder on electric bookkeeping and accounting machines built by International Business Machines Corp. The lighting arrangement was originated by the General Electric Co. as a result of an intensive study. The new IBM key punch machine on which the equipment now is standard is depicted in *Fig.* 5.

In the effort to increase the efficiency of operators of this type of machine in the General Electric statistical department at Nela Park the initial step was a change in the location of the bracket holding the papers which contain figures to be tabulated. By bringing this member to a more convenient position the output of the department was raised, but the important supplement which effected still higher production was an auxiliary lighting system of the study lamp type.

Better Lighting—Less Fatigue

Production subsequently reached a permanently higher level of about fifty per cent. Tests indicated that the eye muscles of the operators were three times as fatigued when the day's work was done under lower levels of illumination as they were under the higher levels.

This lamp, the creation of a committee of the Illuminating Engineering Society, is mounted on an arm attached directly to the key punch machine as shown in *Fig.* 5. Positioned slightly above the eye level of the operator, it consists of an opal glass bowl that diffuses and reflects the light produced, and an opaque parchment shade. Equipped with a 100-watt lamp, the unit furnishes approximately sixty foot candles of illumination on the work, minimizes direct and reflected glare, and produces soft and restful lighting over the entire working area of the machine. A reduction of more than sixty-seven per cent in errors was effected over those recorded before any supplementary lighting was installed. This case alone bears witness to the importance of the designer's task in considering built-in lighting.

Two Types of Lamps Combined

Equipment to satisfy diversified requirements is rapidly becoming commercially available. For instance, there is a new self-contained industrial lighting unit with color characteristics said to approach actual daylight more closely than any light source yet developed. This has just been announced by General Electric Vapor Lamp Co. and consists of a unit in which a circular mercury-vapor tube and an incandescent lamp are combined beneath one reflector to provide the desired spectral balance. It is recommended particularly for industrial applications involving accurate color differentiation, critical inspection or manufacturing operations which embody difficult visual problems.

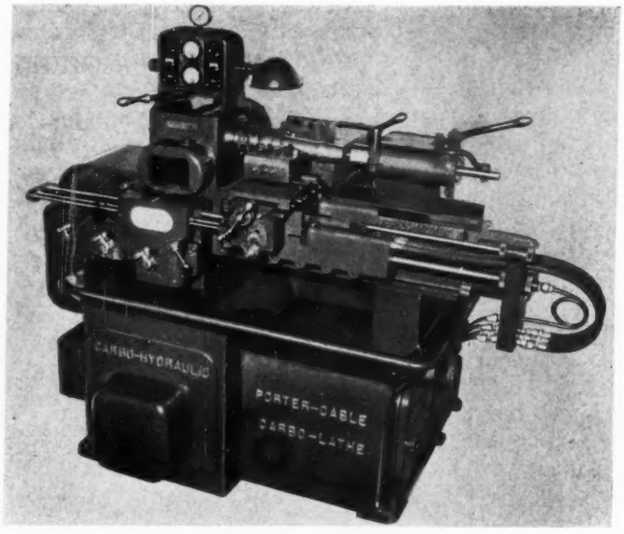
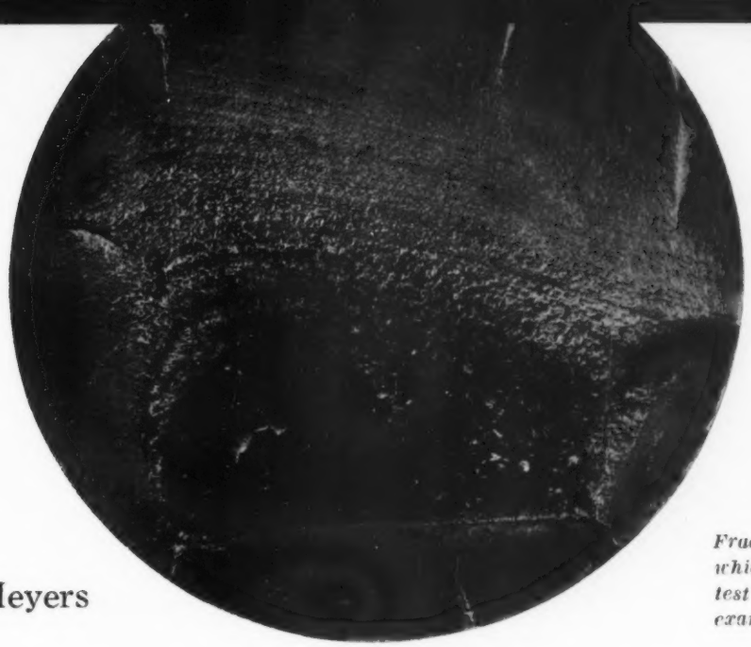


Fig. 7—Machine tools such as this are being designed with built-in lighting systems to facilitate operation

In the heavier classes of machinery and equipment, the machine tool provides a noteworthy example of the possibilities of built-in illumination. Lathes—the Porter-Cable unit, *Fig.* 7, is a pertinent instance—grinders, and other types are rapidly adopting it. The advantages are manifold, from a sales aspect as well as from a performance point of view.



Fracture of a truck axle shaft which failed under severe test conditions. This is a good example of failure due to too high a stress

By Willis G. Meyers

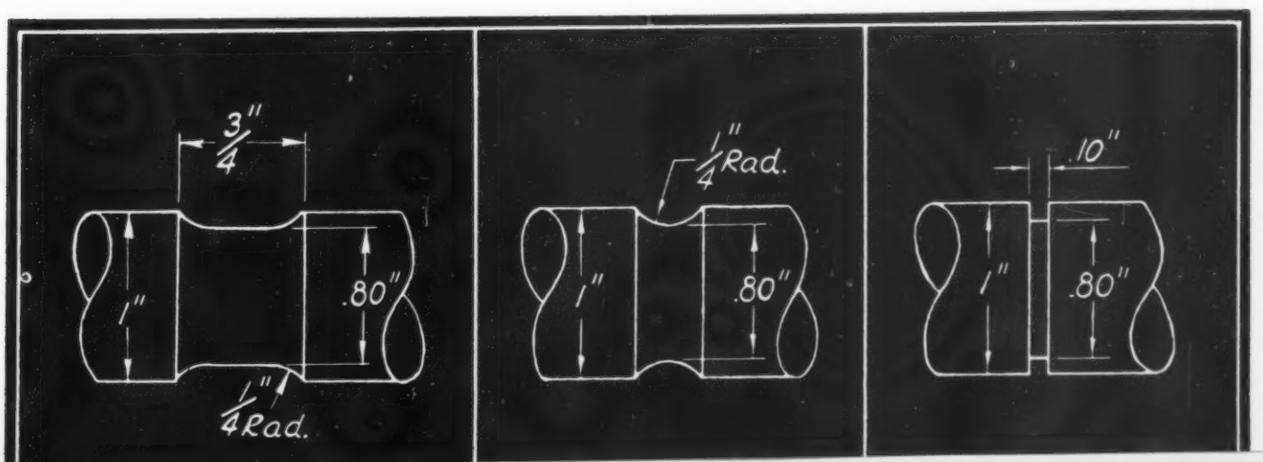
Stress Concentration Leads to Design Failure

FAILURES of steel parts are due, broadly, to (1) faulty design or improper or careless methods of manufacture, and (2) defects which are inherent in the material. In the first category are included failures due to overloading or stress concentration, which generally result from improper design, assuming that the machine is properly cared for in service. Overloading can, however, be caused by faulty manufacturing, such as the machining of a sharper fillet than is called for, with a resultant concentration of stress. Failures due to the material can usually be traced to some defect in the steel introduced during one of the many operations, both metallurgical and mechanical, through which it passes on its way from the furnace to the machine shop and its final assembly into the product.

While we believe that the use of the mathematical formula is indispensable in the design of almost any machine, still a great deal depends upon the judgment and experience of the machine designer. Someone has said that a design is not right unless it looks right, and many experienced designers can produce machines of considerable complexity with the use of very little mathematics.

One of the details of great importance in ma-

Fig. 1—Left—Life values of pieces designed as shown were the highest of any of the designs depicted in the illustrations. Fig. 2—Center—The stress in a neck such as this one is much less than that which would be encountered in a sharp vee groove. Fig. 3—Right—Specimen with a square neck showed a twenty-four per cent greater endurance than one with a radial groove



chine design is the avoidance of regions of stress concentration. It seems almost platitudinous to discuss the effects of notches, grooves, and sharp fillets in highly stressed parts. The results of such design mistakes greatly reduce the resistance of the part to fatigue, to impact, or to vibratory stresses. This is so well known that it would seem that this prolific source of failure should have been completely eliminated in modern design. It is a fact, however, that there are still some designers who do not yet realize the importance of proper filleting. A common fault is not the complete absence of a fillet, but the use of a fillet that is entirely too small. We have seen fillets of 1/64 radius on crankshafts and automobile rear axles.

One of the ideas that has become universally embedded in our textbooks on the mechanics of materials is that of the elastic limit, or that limiting stress below which a metal returns to its original shape after the load is removed, and below which it suffers no permanent deformation regardless of the number of times the loading is repeated.

May Fail Below Elastic Limit

The experiments of Wohler (1859-1870) however, and the practical experiences of railroad engineers, and later of automotive and aeronautical engineers, have developed the fact that sometimes, under repeated stresses, metal parts fail under stresses well below their elastic limits. It has been found that, with ductile materials, the failure is in the nature of a sudden snapping off at the point of fracture.

The obvious explanation of this phenomenon was the fact that under repeated loading the metal underwent some internal change of structure. The surface at the fracture appeared rough and jagged, suggesting a crystalline structure. Therefore the metal was said to have become "crystallized" and the term "crystallization" came to be applied to the sudden failure of metals under repeated stresses.

Fatigue Failures Are Sudden

Fatigue failure takes place suddenly and, unless the part is closely watched, without warning. If, during the life of the machine, periodic examinations of the surface can be made, there can often be detected a small crack which spreads under the stresses of operation until failure suddenly occurs in the remaining porton of the section.

These cracks form even in soft and ductile metals and have been known to occur in Armco iron.

An investigation of localized stress is the logical starting point in a study of the cause of fatigue. Localized overloading is generally caused by improperly designed grooves or fillets, tool marks, foreign inclusions in the steel, etc. In many cases corrosion inaugurates and accelerates fatigue. This interesting phenomenon, known as "corrosion fatigue," has only been investigated recently and is treated later in this article.

A recent investigation of the effects of different shapes of fillets and grooves on fatigue failures has been carried out by the Spencer Mfg. Co. and the results have been published.

As fatigue is largely responsible for the failure of axle shafts, the tests conducted were made in an attempt to develop criteria for the design of those portions of axle shafts which are susceptible to fatigue failure. All of the specimens used were made from SAE 3140 steel. This material was selected because of its deep hardening characteristics and uniform structure. The bars were heat treated in the usual manner and then drawn to 321 brinell. They were turned and ground to a diameter of one inch and then necked in the center as shown in the illustrations, *Figs.* 1 to 7.

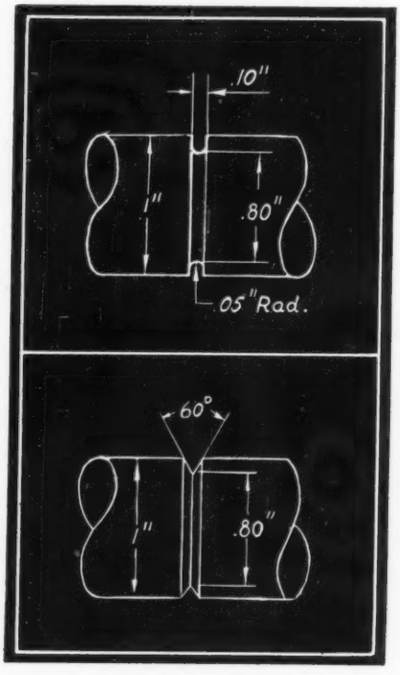


Fig. 4—Top—Distribution of stress in a radial groove of this type is not as good as the distribution in a square groove. Fig. 5 — Bottom—A vee groove introduces much more concentrated stress at the bottom

The test pieces were run on a rotating beam fatigue-testing machine of the Farmer or Wohler type, in which they were subjected to a surface stress of 77,000 pounds per square inch at the minimum diameter.

The following life values were obtained after ultimate fracture of the shaft:

Fig. 1.	81,000	revolutions
Fig. 2.	75,400	revolutions
Fig. 3.	19,000	revolutions
Fig. 4.	14,450	revolutions
Fig. 5.	13,530	revolutions
Fig. 6.	13,800	revolutions
Fig. 7.	12,650	revolutions

It is interesting to note that the specimen il-

lustrated in *Fig.* 3, which has a square neck, showed 24 per cent greater endurance than that of *Fig.* 4, which has a radial groove. This is probably explained by the fact that the square-necked piece had better distribution of stress. That is, the stress was distributed over the entire width of the neck, whereas in the other case the stress was concentrated at the bottom of the groove and confined to a very small width.

This does not mean that a sharp corner is better than a fillet, but it may be better if the fillet reduces the available stress area to such an extent that the stress per unit of area is higher than it would have been had a smaller fillet or sharp corner been used.

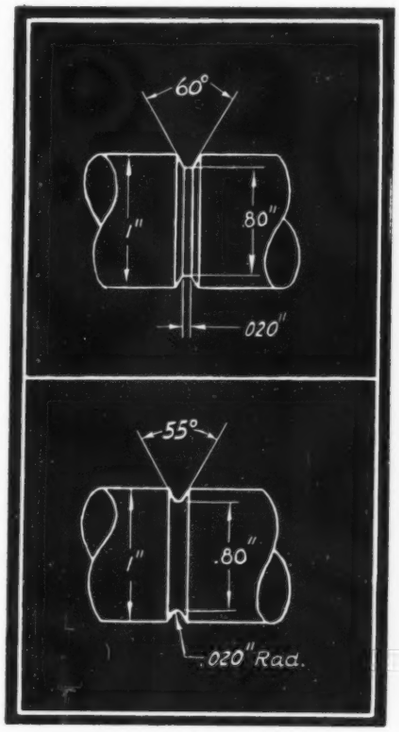


Fig. 6—Top—Life values were obtained, after ultimate fracture of the shafts, from test pieces run on a rotating beam fatigue - testing machine in which the pieces were subjected to a surface stress of 77,000 pounds per square inch at the minimum diameter. The cross section shown is one of those tested. Fig. 7 — Bottom—A combination of vee groove and radial section was also investigated

It will be noted that the specimen shown in *Fig.* 2 lasted for 75,400 revolutions while that of *Fig.* 5 showed an average of only 13,530 revolutions. The explanation of the great difference between the endurance values of these two specimens is obvious, as the stress is much more concentrated at the bottom of the sharp vee groove.

Deep Tool Marks Dangerous

While sharp corners are highly detrimental, it must also be remember that, in producing them, deep tool marks often result and these are still more dangerous. Good machining is a factor which cannot be overemphasized, especially with respect to the quality of the finish. Deep tool marks are a frequent starting point for fatigue failures. In gear cutting, the root of the tooth is often full of tool marks or may even have an offset where the finishing operation has not been carried far enough to clean up the root of the tooth. As this point is highly stressed, good finish is important. In connecting rods where the surface is milled for the cap bolts, liberal fillets should be provided so that the stress is distributed.

Sometimes a fillet in a soft material may be turned into a sharp corner or notch when in contact with a harder material having a sharp corner and the assembly is subjected to considerable vibration.

Care in Manufacturing Necessary

From the foregoing it is evident that the avoidance of failure due to localized stresses is dependent upon a number of details. Failure may start in a fillet that is too small, but it may also start in a liberal fillet that has a rough surface or a sharp tool mark in it. Assemblies of hard and soft metals must also be watched for dangerous possibilities. In extremely highly stressed parts the difference between early failure and almost indefinite service depends to a large extent on the care taken in manufacturing, assuming, of course, that the part has been designed properly in the first place.

In discussing failures due to faulty material, two divisions naturally suggest themselves. In the first place, the steel may be inherently bad. It may contain slag, blow holes, or other inherent defects or it may exhibit seams or other surface imperfections. In the second place it may have been improperly processed at some stage of its manufacture. It may have been improperly rolled or forged or heat treated.

Imperfections Often Found

In spite of the advances made in the art of steel making, especially in the manufacture of alloy steels, imperfections are still to be found. And in spite of the improvements in the various processes to which the ingot is subjected before it appears as the finished part, there is occasional evidence that faulty rolling mill and forging practice still exists. There is still some careless heat treating being done; it is not frequent but it occasionally becomes evident in a failure, especially with carburized parts.

Steel making is an art. It is developing rapidly but is still far from the stage where the makers can supply manufacturers with steel free from inclusions. Many engineers understand that there are chemical variations in different bars of the same heat. Variations in carbon content are the most noticeable and these increase as the carbon content increases. The spread of elements is not great and it is not known that failures have ever been due to this cause. Present steel treating equipment is not

accurate enough to bring out these variations, and besides there are other factors which have profound effect upon the hardening of steel. Where very narrow hardness ranges are required, variations in the drawing temperature must be made to accommodate different heats of steel. By processing one heat at a time and keeping all parts identified with that heat in one lot, satisfactory results can be obtained.

Slag Particles Originate Cracks

Lucas and Styre have shown conclusively that fatigue cracks frequently have their origin in small clusters of slag particles. In the work done at Wright Field on fatigue failures a mass of evidence has been accumulated which shows without doubt that nonmetallic inclusions are frequently responsible for, or at least accelerate, fatigue.

Steel users, when confronted with unsatisfactory performance in a steel of a given analysis in a particular application, are too ready to lay the blame solely on the composition. They forget, or do not know, that the physical properties of the steel, particularly after heat treatment, depend to a great extent upon the care that has been observed in its manufacture. Chemical specifications without end have been created in attempts to obtain satisfactory steels for specific purposes, when steels of standard analyses, produced under carefully controlled conditions, would have served the purpose just as well or better, and generally at considerably less cost.

Uniform Steel Is Goal

In recent years some steel companies have made extensive investigations to determine the underlying metallurgical causes for the different inherent characteristics of steels that are not explained by the ordinary physical and chemical tests. They are now endeavoring to apply systematically the knowledge gained in this research in every detail of steel making, with the object of producing steel that is uniform not only throughout each heat, but from heat to heat as well.

One of the fundamental factors affecting the characteristics of steel, particularly steels that must be carburized or heat treated, is the austenitic grain size. This property has been controlled to a greater or lesser extent in the manufacture of tool steel and special alloy steels, but its positive control in the manufacture of basic open hearth carbon steel has been considered by some to be impossible. However, by systematic supervision of the processes for making basic open-hearth carbon steel, the grain size, as determined by the standard test, can now be controlled to produce steel consistently with either a fine or coarse grain as desired.

An inherently fine-grained steel is distinguished primarily by the fact that it has a high coarsening temperature; that is, a higher temperature is required to produce a coarse grain than in an inherently coarse-grained steel.

Although the tensile strength and yield point of steel does not appear to bear any relation to grain size, a coarse-grained steel has slightly lower tensile elongation and markedly lower reduction of area than a fine-grained steel. The most prominent effect of grain size is on the toughness of hardened steels. The difference in impact resistance is considerable and is in favor of the fine-grained steel.

For steel in the normalized condition, however, grain size has much less significance. A coarse-grained steel is somewhat harder and less ductile.

A high coarsening temperature makes possible the consistent attainment of a fine grain size in heat treated steel without extreme precautions in heat treatment. There is less danger of overheating light sections and projections and carburized steel can be quenched from the pot without embrittlement. These are advantages of no mean significance. The major objectionable characteristic of fine grained steel is less penetration of hardening, but this can be corrected by a slight increase in manganese content.

A further discussion of fatigue and its importance to design will be included in the final section of this article to be presented in the February issue of MACHINE DESIGN. Topics to be discussed will include points to be considered in calculating the strength of gears, corrosion fatigue, and the influence of grain flow on the fatigue strength of forgings.

To Be Continued

Glass Serves as Insulator

GLASS, in fibrous form, is fast assuming new importance in industry with the introduction of glass wool—in a fluffy, almost snow-white mass—for insulating purposes. This material emerges from furnaces on a conveyor, a continous line of downy material about one yard wide and four inches deep. It is cut to size by an automatic slicer into packs which later are placed between walls, forming an enveloping blanket of protective material that is fire, vermin and moisture proof and which is impervious to the attacks of all acids except one, hydroflouric, used to etch glass.

Glass air filters are another use of fibrous material as manufactured by Owens-Illinois Glass Co. The fibers are assembled into mats about two inches thick and sprayed with an odorless nonevaporating chemical adhesive. Air passing through these filters is cleaned of all dust, pollen and other foreign matter.

New Machines Indicate Design Trends

CORRECT lighting has such a tremendous effect on the efficiency with which a machine is operated, and a consequent effect on the opinion in which those machines are held, that it is little wonder designers are leading a rush toward built-in lighting. By including attention to the lights in the original design the engineer can be certain that his machine will be correctly illuminated throughout its life. Further, this consideration of the human element not only makes a booster for the machine out of the operator, but it enhances the favorable opinion of the purchaser who receives faster and more nearly perfect work from the machine.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Air Conditioning

Industrial Equipment, Surface Combustion Corp., Waterbury, Conn.

Baffle Sprayless Type Unit, Economy Equipment Co., Chicago.

Chemicals

Acid Ejector, Lea Mfg. Co., Waterbury, Conn.

Solid Bowl Centrifugal, Bird Machine Co., South Walpole, Mass.

Laboratory Homogenizer, Cherry-Burrell Corp., Chicago.

Clayworking

Brick Making Machine, Dunn Mfg. Co., Holland, Mich.

Construction

Concrete Vibrators, Master Vibrator Co., Dayton, O.

Portable Gravel Clay Stabilizer Plant, Gravel Equipment Mfg. Co., Minneapolis, Minn.

Utility Grader, A. W. French, Chicago.

Floor Sanding Machine, Trimson Mfg. Co., Cleveland.

Dairy

Farm Milk Cooler, Milk Cooling Equipment Co., Grand Rapids, Mich.

Centrifugal Heater, Chester Dairy Supply Co., Chester, Pa.

Domestic

Room Heater, Hexcel Radiator Co., Racine, Wis.

Humidifier, P. Edelman, Chicago.

Automatic Water Heater, Automatic Electric Heater Co., Inc., Pottstown, Pa.

Industrial

Unit Heaters, Dravo-Doyle Co., Pittsburgh.

Mobile Yard Crane, Bucyrus-Erie Co., South Milwaukee, Wis.

Monorail Electric Hoists, Northern Engineering Works, Detroit.

General Duty Gasoline Engine, Scripps Motor Co., Detroit.

Two-Stage Compressor, Chicago Pneumatic Tool Co., New York.

Metalworking

Die Sawing and Filing Machine, Foley Mfg. Co., Inc., Minneapolis, Minn.

Portable Sanders, Black & Decker Mfg. Co., Towson, Md.

Spline Shaft Grinder, Fitchburg Grinding Machine Corp., Fitchburg, Mass.

Office

Calculator, Allen Calculators Inc., New York.

Duplicator, Flash-O-Graph Corp., Neenah, Wis.

Accounting Machines, Underwood Elliott Fisher Co., New York.

Calculator, Marchant Calculating Machine Co., Oakland, Calif.

Plating

Semiautomatic Plating Machine, Udylite Corp., Detroit.

Power Boating

Outboard Motors, Outboard Motors Corp., Milwaukee.

Rubber

Automatic Slicer, Utility Mfg. Co., Cudahy, Wis.

Electric Homogenizer, Club Aluminum Products Co., Chicago.

Textile

Embossing Calendar, Morrison Machine Co., Paterson, N. J.

Raw Stock Dyeing and Bleaching Machine, Vacuum Dyeing Machine Co., Chattanooga, Tenn.

Ladder-Tape Loom, Fletcher Works, Philadelphia.

High Speed Fingering Machine, Lamb Knitting Machine Corp., Chicopee Falls, Mass.

Woodworking

Radial Saw, J. D. Wallace Co., Chicago.

Design Features in New Machines

A Pictorial Presentation of Recent Machinery from the Standpoint of Design.

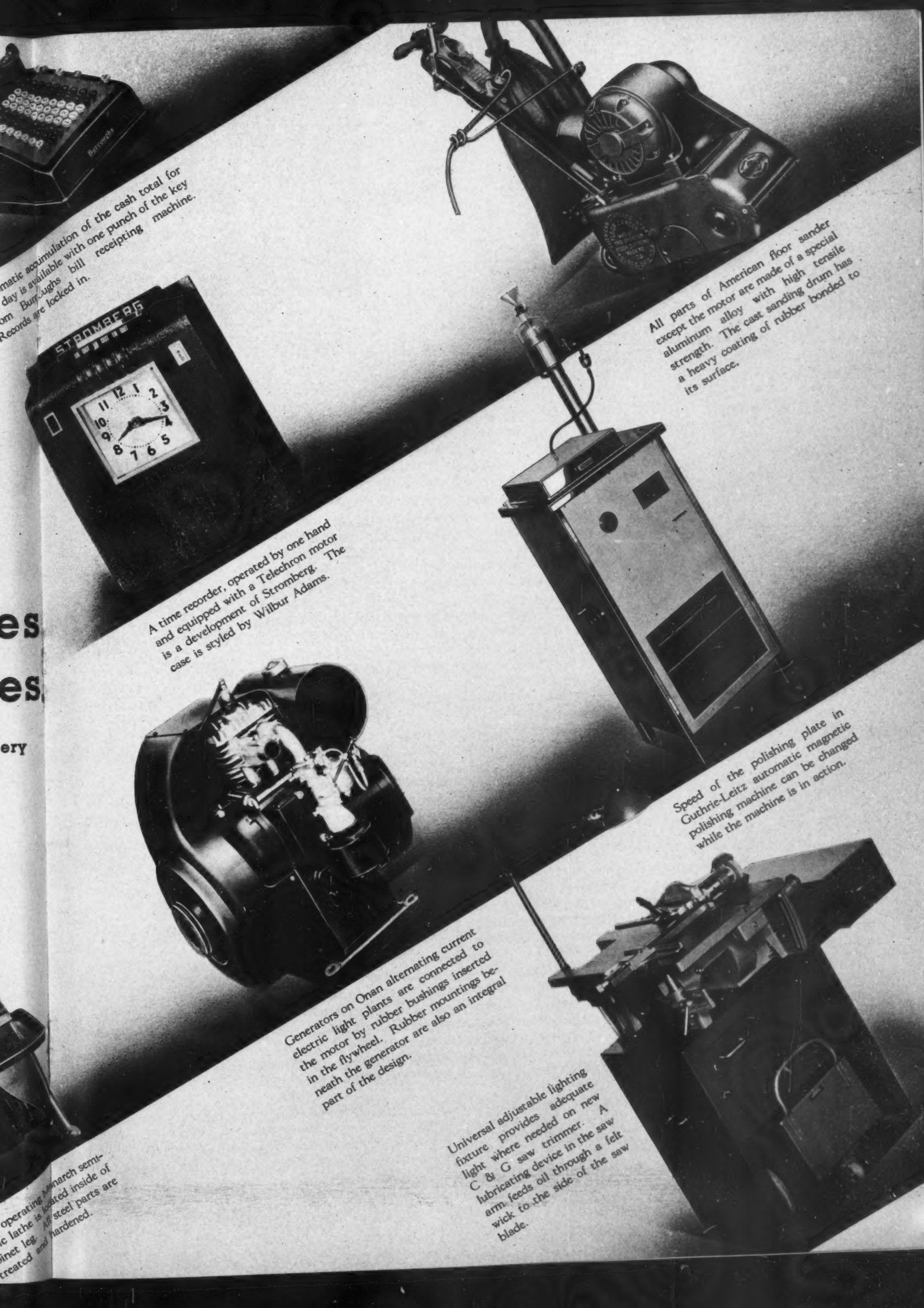
Torque motors are being applied as means of operating controllers for electric hoists in the new Robbins & Myers units. The drum controller is the same as used for pendant rope construction.

The crank handle through worm and worm gear affords angular adjustments for the complete grinding head on new Hisey-Wolf portable grinder. Unit is equipped with precision bearings.

Automatic accumulati
the day is available
from Burroughs
Records are locke

Fully automatic oiling by oil pump and drip feed is provided on Bell & Howell sound and picture production printer. The complete machine is interlocked so that it is impossible to start the machine under conditions that would be unsafe or would waste film. A positive gear drive is used throughout.

Motor for operating Monarch se
automatic lathe is located inside
the cabinet leg. All steel par
are treated and hardened


matic accumulation of the cash total for
day is available with one punch of the key
om Burroughs bill receipting machine.
Records are locked in.
STROMBERG
A time recorder, operated by one hand
and equipped with a Telechron motor
is a development of Stromberg. The
case is styled by Wilbur Adams.
All parts of American floor sander
except the motor are made of a special
aluminum alloy with high tensile
strength. The cast sanding drum has
a heavy coating of rubber bonded to
its surface.
Speed of the polishing plate in
Guthrie-Leitz automatic magnetic
polishing machine can be changed
while the machine is in action.
Generators on Onan alternating current
electric light plants are connected to
the motor by rubber bushings inserted
in the flywheel. Rubber mountings be-
neath the generator are also an integral
part of the design.
Universal adjustable lighting
fixture provides adequate
light where needed on new
C & G saw trimmer. A
lubricating device in the saw
arm feeds oil through a felt
wick to the side of the saw
blade.
operating Monarch semi-
c lathe is located inside of
binet leg. All steel parts are
treated and hardened.

MACHINE DESIGN

Higher Production Necessary in Replacing Lost Physical Frontiers

THAT a new "social frontier" is necessary to replace our lost physical frontier is the opinion of Ralph E. Flanders, last year's president of the American Society of Mechanical Engineers. This thought was expressed in a lecture presented at the recent annual meeting of the organization in New York. Such a belief, coming from so eminent an engineering authority, is well worth attention.

Whereas our physical frontiers have provided to a greater or lesser extent an impetus for expansion over the past three hundred years, there is one aspect of our business, economic and home life that is still open to wide advancement and could be used psychologically instead, namely, standards of living. Fallacies of overproduction, technological unemployment and overinvestment fall into the discard when it is considered that we have never had a decent standard of living generally throughout the country; that on technology alone can our hopes for the future be founded; and that an adequate provision of goods and services to the masses requires larger and more efficient productive facilities than have ever been dreamed of.

Just how these new "social frontiers" are to be entered into and occupied is explained by Mr. Flanders in the urge to attain better goods and services at less relative cost through the expansion and refinement of our productive machinery and processes. This answer, we believe with due modesty, tends to confirm a thought that has been reiterated many times in these columns in recent years—that more and better machinery is essential in our quest for recovery and stabilization.

Watch 1936!

THOSE engineering executives who place faith in business predictions must have had a lot of satisfaction in reading the forecasts for 1936. Summaries of last year's business have been equally encouraging, particularly from the standpoint of machine requirements.

As brought out in a survey conducted by the National Machine Tool Builders' associaton, nearly a billion dollars was delegated during the last six months of 1935 to plant expansion and re-equipment activities. This is further tangible evidence that the capital goods industries have definitely turned the corner.

Thus it would seem also from 1936 forecasts of financial, business and engineering authorities. And with machinery constituting a major portion of the capital goods of the country there's only one logical conclusion—better times ahead for designers of machines!

litorial

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Designing Plain Bearings

To the Editor:

IN THE determination of load capacities of plain bearings it is very confusing to one who is occasionally confronted with this problem to find that each of the many different formulas on the subject give widely different results. The designer therefore realizes that his final figures can only be as accurate as his practical knowledge guides his choice of calculation.

The graph on the following page was constructed to present a clearer picture of the balance of relations of the various factors involved. It may be well to state that the relations as shown are slightly flexible as influenced by bearing clearance, quality of oil, rigidity of mounting, etc., which factors it is almost impossible to include in a graphic chart.

In the application of the chart, the dash lines indicate the solution of an example, namely that a 3-inch shaft running at 300 RPM has a surface velocity of 236 feet per minute, and assuming a coefficient of friction of 0.002 and an operating temperature of 160 degrees, the permissible bearing pressure will be 560 pounds per square inch. Now if a total load of 7800 pounds is to be carried, an area of 14 square inches is necessary and using a length to diameter ratio of 1½, the bearing length is found to be 4½ inches.

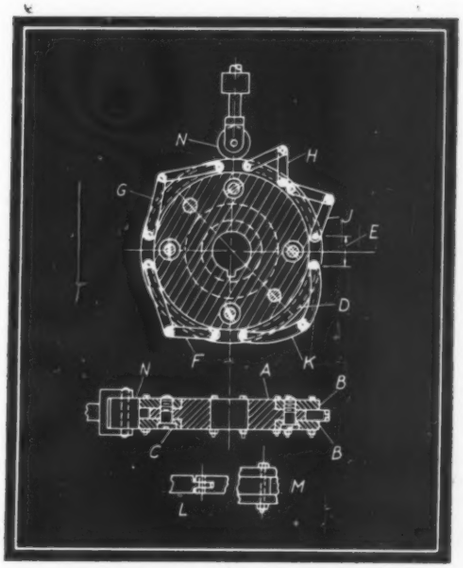
—FRANK SCHUBERT, *designer*,
Loose Wiles Biscuit Co.

Designs Adjustable Cam Lobes

To the Editor:

ADJUSTABILITY of cam lobes in a cam is of importance in many cases in order that a machine may have as wide a variety of feed movements as possible. In the accompanying illustration is shown what might be termed a toggle joint type of cam, in that the lobes are formed by links of the same type as those used in toggle joints.

It consists of a central flanged bearing *A*, to which are fastened side plates *B* by means of the fillister head screws *C*. These side plates have opposing circular slots *D* milled through an angle of ninety degrees less a distance *E*,



A wide variety of feed movements is provided by these adjustable cam lobes

which is necessary to tie the plate together. Between these plates are inserted the toggle joints *F, G, H, J* and *K*. These lobes are of the usual tongue and groove construction as shown at *L* and are held in place by means of clamp screws as shown at *M*. The cam roller *N* is made wide enough so that it will rest upon the side plates *A* when not in contact with any of the lobes.

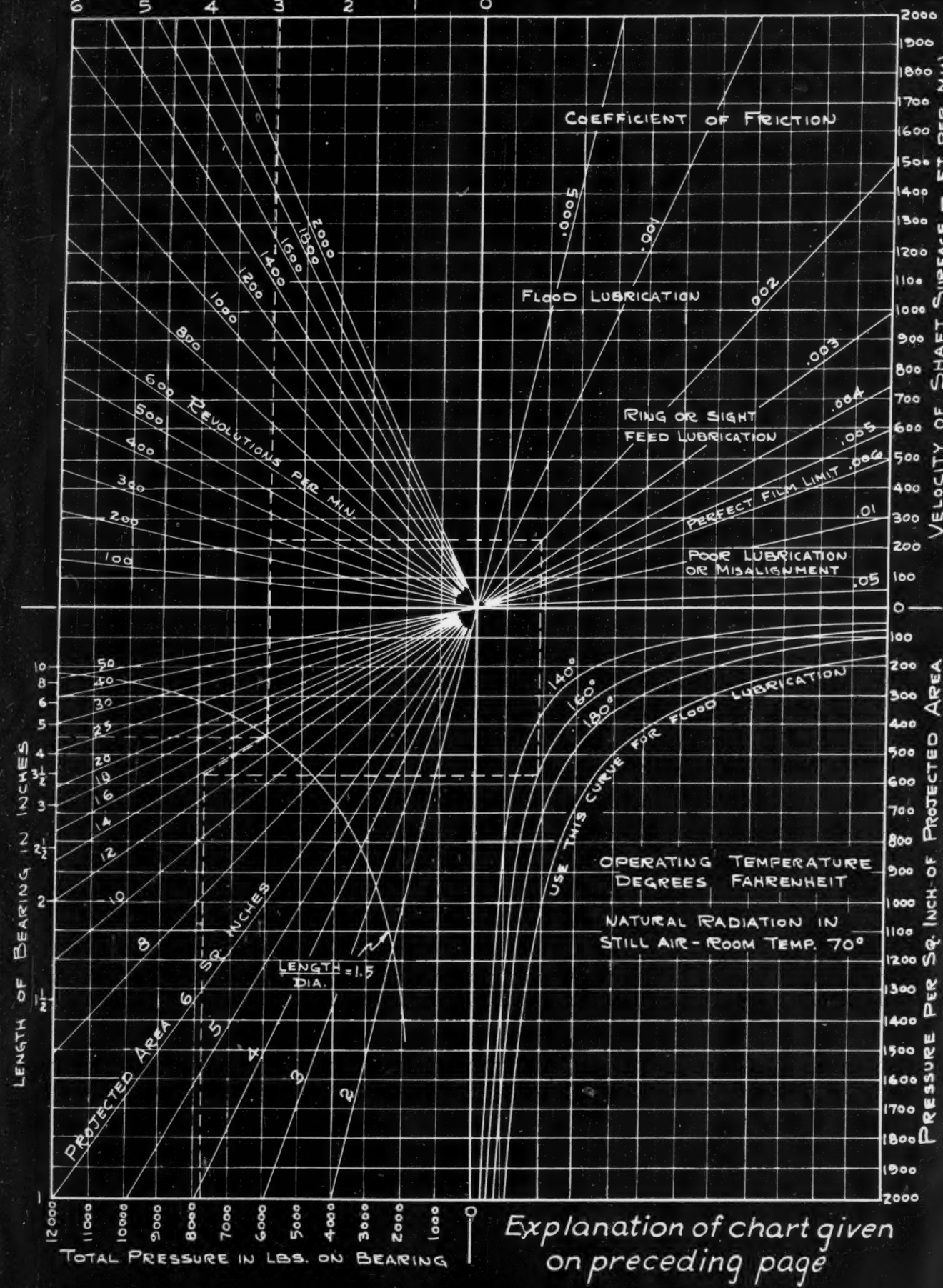
The toggle at *F* is of unequal length and thus gives an unequal rise or fall, as required. The one at *G* is of equal length and will give an equal rise and fall, while at *H* and *J* the two small toggles give a double motion in the same angle. If it is desired to give a smoother action to the cam roll, a curved toggle of the type shown at *K* can be made to give such action. Within the limits of the slots these lobes can be set for any desired rise or fall through any desired angle.

If a group of various types of toggles, that is small ones, curved ones and those of equal and unequal length are kept at hand any variety of movements may be obtained.

This type of cam provides a useful device where from time to time changes need be made.

—JOHN A. HONEGGER,
New York

Designing Plain Bearings


DIAMETER OF SHAFT IN INCHES
6 5 4 3 2 1 0
COEFFICIENT OF FRICTION
.0005
.001
.002
.003
.004
.005
.006
.01
.05
FLOOD LUBRICATION
RING OR SIGHT FEED LUBRICATION
PERFECT FILM LIMIT
POOR LUBRICATION OR MISALIGNMENT
2000 1800 1600 1400 1200 1000 800 600 500 400 300 200 100
REVOLUTIONS PER MIN
VELOCITY OF SHAFT SURFACE — FT. PER MIN.
2000 1900 1800 1700 1600 1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0
LENGTH OF BEARING IN INCHES
10 8 6 5 4 3½ 3 2½ 2 1½ 1
50 40 30 25 20 18 16 14 12 10 8 6 5 4 3 2
PROJECTED AREA SQ. INCHES
LENGTH / DIA. = 1.5
USE THIS CURVE FOR FLOOD LUBRICATION
140° 160° 180°
OPERATING TEMPERATURE DEGREES FAHRENHEIT
NATURAL RADIATION IN STILL AIR - ROOM TEMP. 70°
PRESSURE PER SQ. INCH OF PROJECTED AREA
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
12000 11000 10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 0
TOTAL PRESSURE IN LBS. ON BEARING

Explanation of chart given on preceding page

Do Engineers Lack Proper Training?

To the Editor:

BELIEVING fully all that Albert Foster writes in your December issue (page 42) regarding the value of public speaking, etc. to the engineer, I would like to cite my own experience.

In the past twenty years I have done a good many things in an effort to get more out of my engineering training. I studied correspondence courses covering salesmanship and business administration and had night school work in public speaking. I cannot say enough in favor of the advantages gained.

Short courses in business administration and salesmanship might be advisable in order to arouse interest and promote further study after graduation. Public speaking is not only the most important, but could be included in the curriculum with the elimination of the smallest number of engineering subjects. This would be especially true if engineering matter was used as subject material in public speaking with recitations given in the form of a speech or if speeches replaced some of the written tests.

I would certainly like to see some college give the idea a fair trial.

—H. B. HAZLETON,
C. E. Rogers Co.

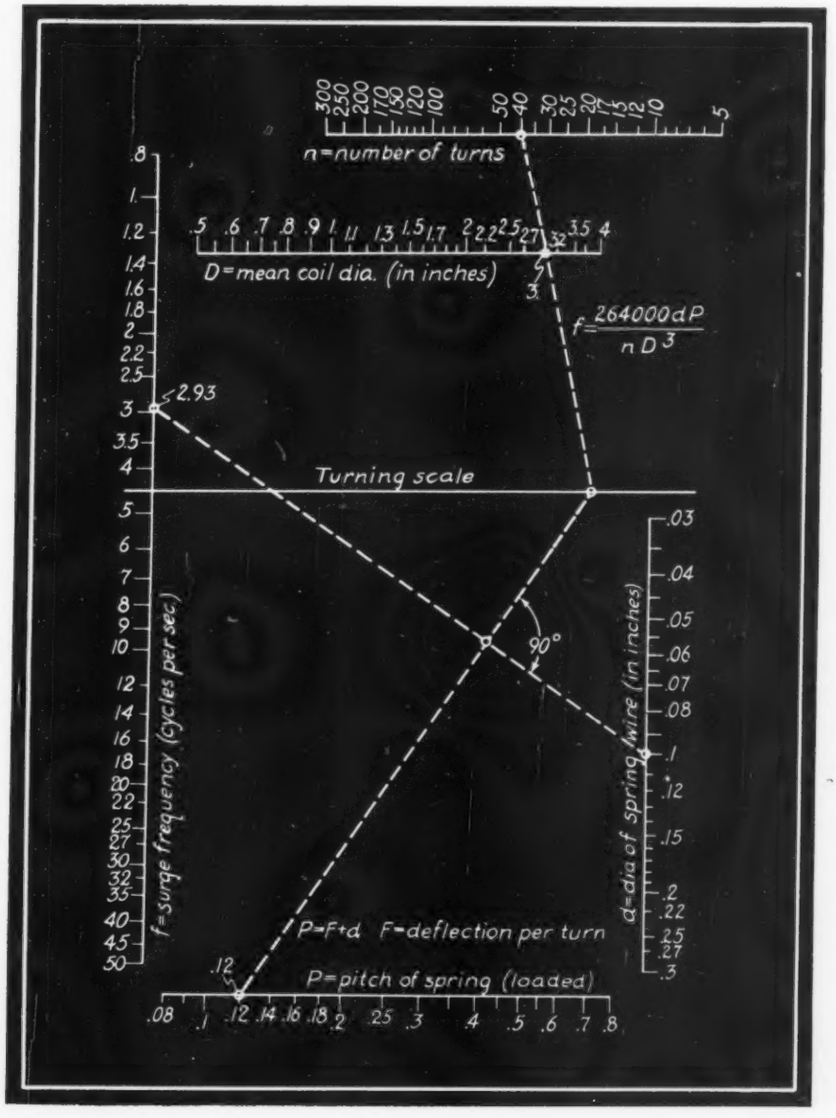
Determines Spring Surge Frequency

To the Editor:

WHEN a long helical spring is suddenly extended (or compressed) the movement of the end coil is communicated to the next coil, and that to the next in succession until the other end of the spring is reached, when the pulse, wave or surge thus formed is reflected back, traveling at a certain frequency back and forth, and with a definite decrement, until it is finally dissipated by friction. If one end of the spring is periodically extended at a rate equal to the surge frequency, resonance may be produced, and then the maximum spring deflection will be much greater than that due to the single extension—even so much as to cause a spring failure.

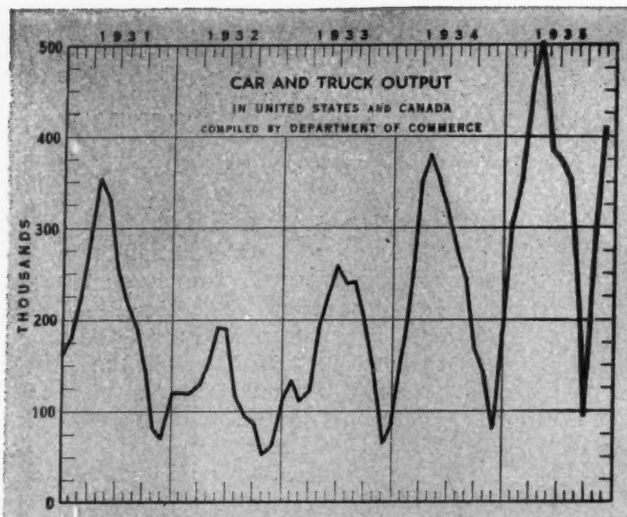
The foregoing is discussed by Professor C. H. Kent in the October MACHINE DESIGN. It is stated therein that the theoretical determination of the exact surge frequency of the spring due to its natural constants is mathematically complex, but an approximate formula is given which agrees with tests within 10 to 15 per cent, the calculated frequencies being that much higher. The writer has further transformed this formula and constructed a nomogram applying to steel springs for the convenient solution of it. The dotted secants show the surge frequency is 2.93 cycles per second for a spring of 40 turns, 3 inches mean coil diameter, of 0.1-inch diameter steel wire, when extended so that the pitch is .12-inch which is 0.002-inch deflection per turn.

—C. P. NACHOD, *vice president*
Nachod U. S. Signal Co. Inc.

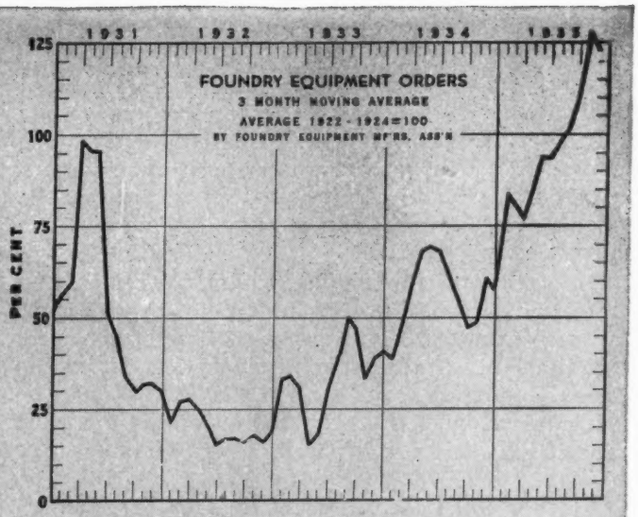


Nomogram solves formula for determination of surge frequency of springs

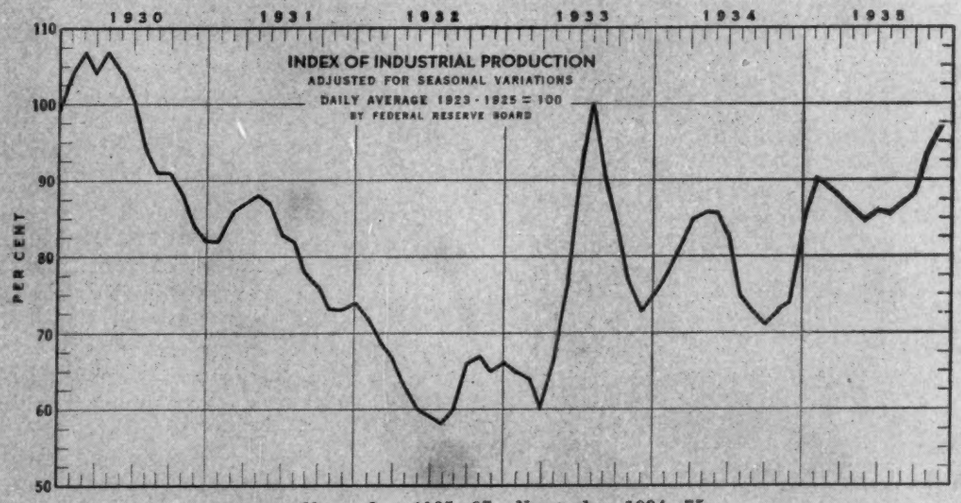
How is Business?



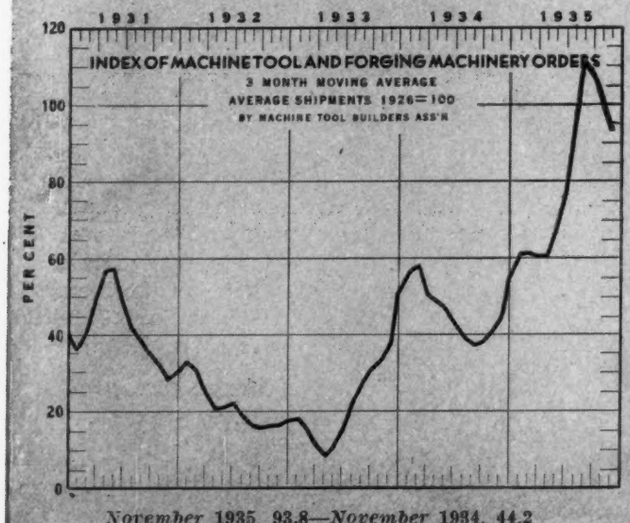
November 1935, 411,520—*November* 1934, 85,179



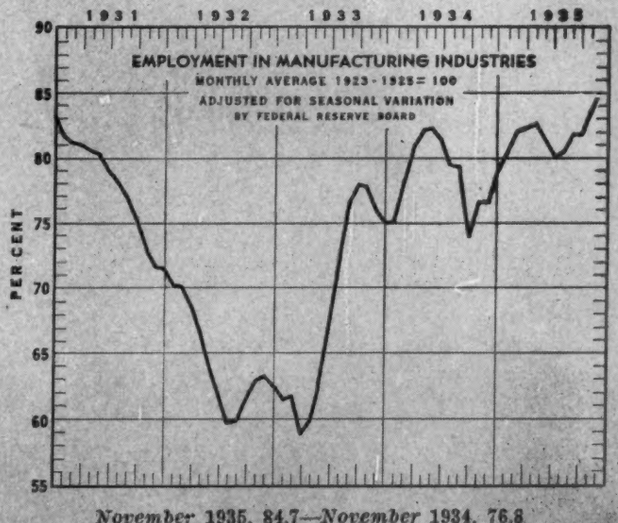
November 1935, 122.9—*November* 1934, 60.7



November 1935, 97—*November* 1934, 75



November 1935, 93.8—*November* 1934, 44.2



November 1935, 84.7—*November* 1934, 76.8

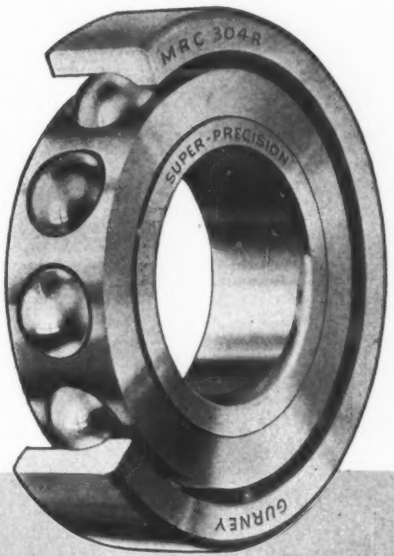
M-R-C BALL BEARINGS

help to make history with the CHINA CLIPPER

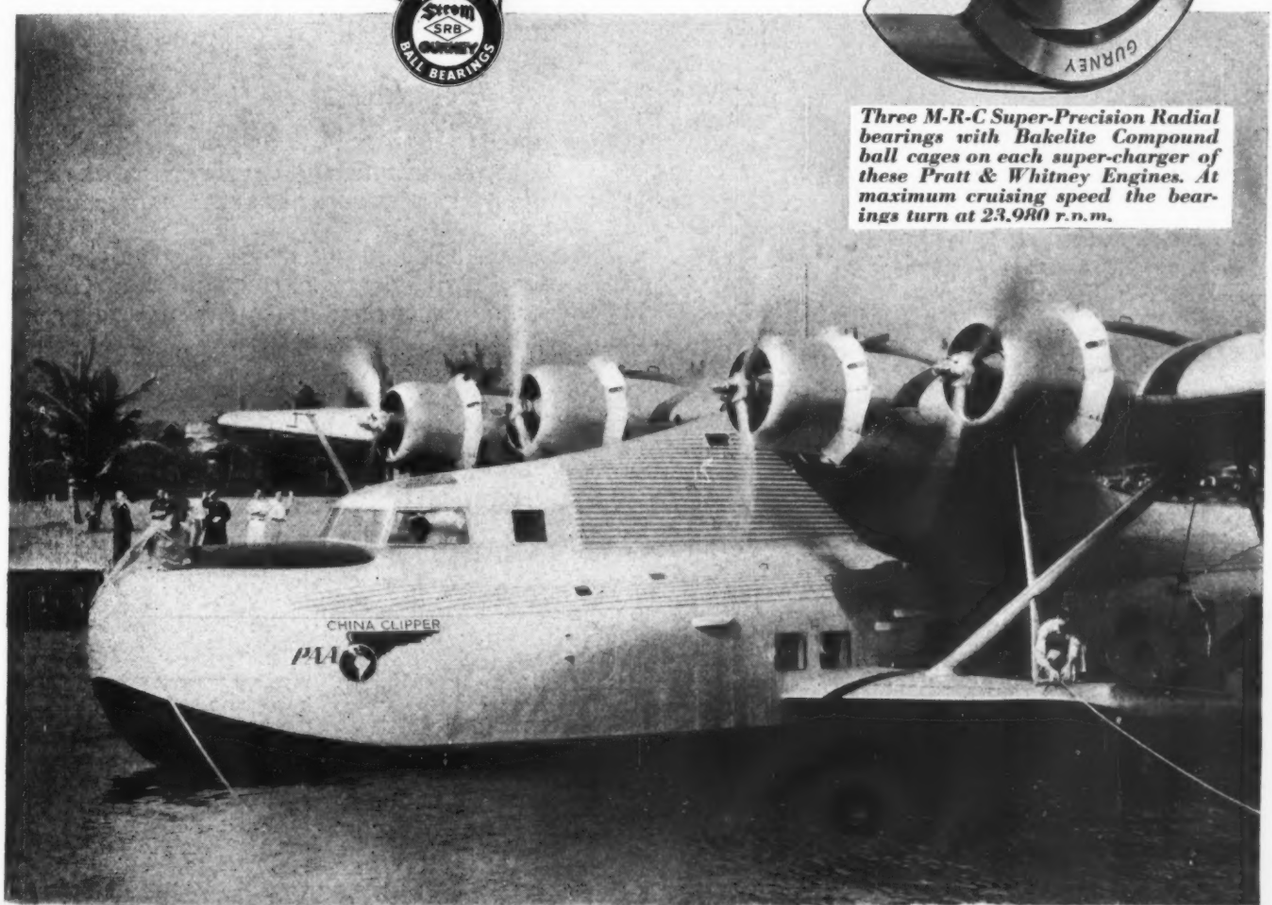
Pratt & Whitney specified M-R-C Ball Bearings for the engines used in this history making ship. And the record—less than 120 flying hours from Alameda to Manila and return—proves their confidence in M-R-C was justified. The accuracy and dependability built into M-R-C bearings helped the Pratt & Whitney Twin Wasps drive the China Clipper over 18,000 miles of sea, maintaining the schedule of a crack train.

M-R-C engineers are available for advice or suggestions on any ball bearing installation. Make use of this helpful service.

MARLIN ROCKWELL CORPORATION - JAMESTOWN, N. Y.
FACTORIES: JAMESTOWN, N. Y. • PLAINVILLE, CONN. • CHICAGO, ILL.



Leadership
M-R-C Strom SRB Gurney BALL BEARINGS



Three M-R-C Super-Precision Radial bearings with Bakelite Compound ball cages on each super-charger of these Pratt & Whitney Engines. At maximum cruising speed the bearings turn at 23,980 r.p.m.

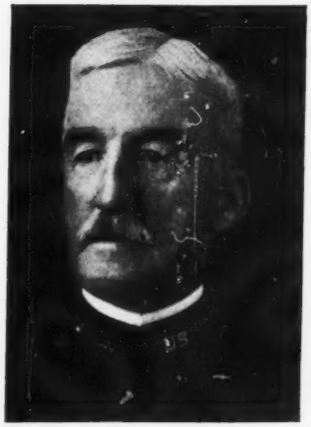
M-R-C BALL BEARINGS
GURNEY SRB STROM

MEN of MACHINES

FOR his engineering skill and invention in the development of modern armament, Col. Rogers Birnie recently was acclaimed by the Army Ordnance association as one of its 1935 medalists. It honored him as a leader in the field of modern gun construction and as a technical officer of distinguished service to the ordnance cause.

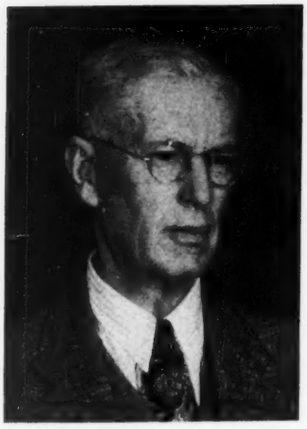
Col. Birnie was graduated from the United States military academy in 1872. During the Spanish-American war he served the seventh army corps in Havana. From 1913 to 1915 he was president of the Ordnance Board.

Pioneer in his advocacy of the built-up forged steel gun in the United States, Col. Birnie also used his best effort toward inculcating a philosophy of ordnance action.



COL. ROGERS BIRNIE

• • •



TO WORTHY C. BUCKNAM goes the 1934 Morehead medal for his outstanding accomplishments in the development of oxyacetylene welding and cutting apparatus, particularly motor-driven welding and cutting machines.

Presentation was made at the recent convention of the International Acetylene association. Born in Mechanic Falls, Me., April 23, 1865, his wide shop experience early gave him a practical grasp of fundamental mechanical principles.

Mr. Bucknam was the first to develop a universal cutting machine capable of cutting any desired shape, regular or irregular. He also designed the first practical portable cutting machine and has been active in many other phases of the oxyacetylene process.

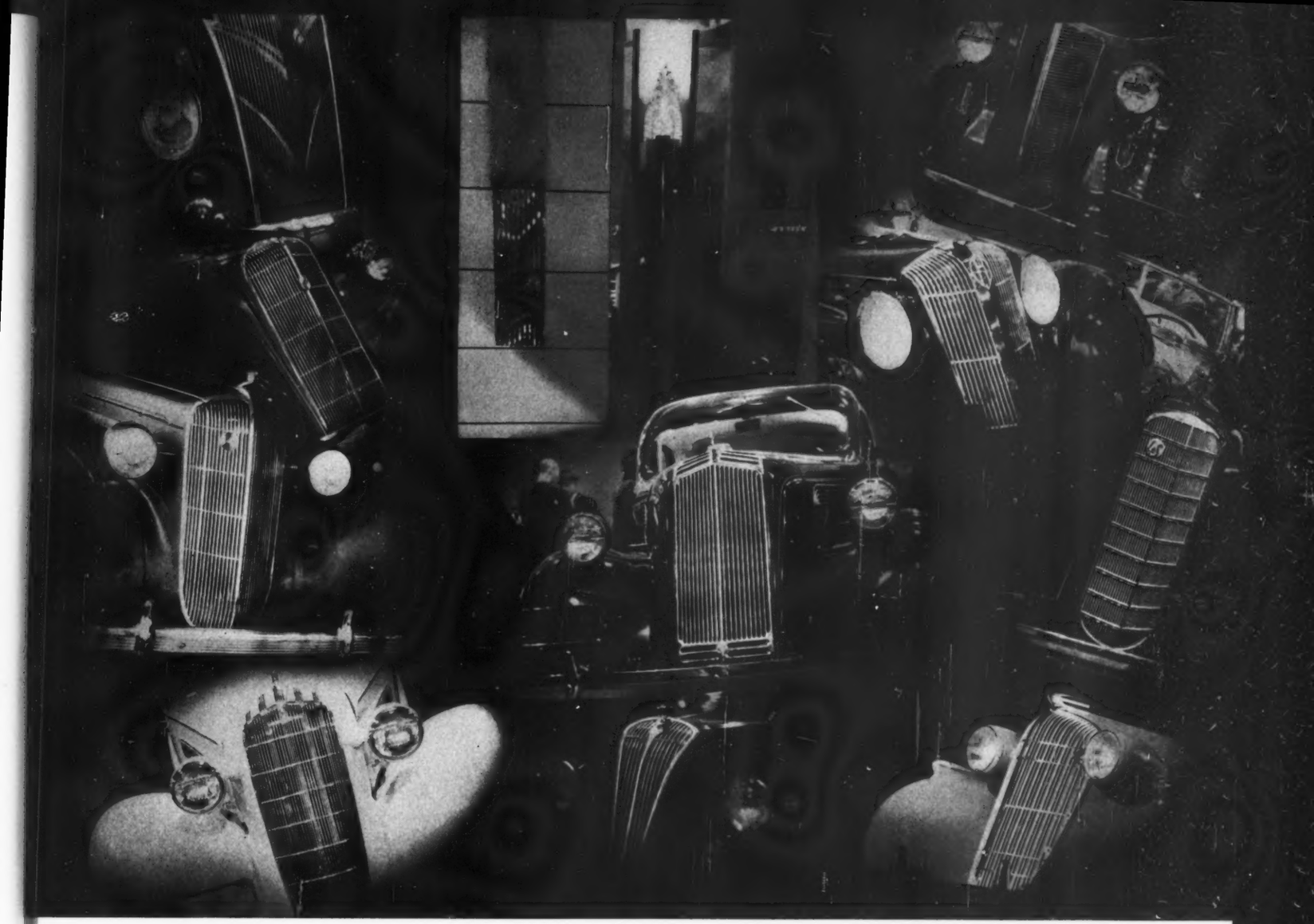
WORTHY C. BUCKNAM

• • •

AS ITS new president, the National Machine Tool Builder's association has elected Norman D. MacLeod. In business life he is the president of the Abrasive Machine Tool Co., founded by his father in 1916 in East Providence, R. I. In that city Mr. MacLeod was born, April 10, 1891. After attending public school, he matriculated at Massachusetts Institute of Technology where he obtained a bachelor of science degree.

Two years of training with Brown & Sharpe Mfg. Co. preceded his affiliation with Abrasive Machine Tool Co. where for seventeen years he has held various positions including that of draftsman, designer, foreman, superintendent and now president. In 1915 he joined the Rhode Island National Guard and saw service in France during the World war with the twenty-sixth

NORMAN D. MACLEOD



IT'S THE NEW "FRONT END" STYLING

"Improved appearance" was the most universal claim at the 1935 Automobile Show. And the most universal new design feature was the ZINC Alloy Die Cast radiator grille. Die castings give these new cars an appearance of solidity, a structural integrity, which they have never gained by any other method of fabrication. The possibility of ZINC Alloy Die Castings doing an equally important job for you should be carefully investigated.

The Research was done and
The Alloys were developed with
HORSE HEAD SPECIAL ZINC
(99.99+% Uniform Quality)
Most Die Castings are specified with this metal.

THE NEW JERSEY ZINC COMPANY

160 FRONT STREET — NEW YORK CITY

TWIN

PRECISION

IN the past 20-odd years many standards have become flexible, and quality has—in many cases—become a variable thing . . . But throughout this period NORMA-HOFFMANN Precision Bearings have been consistently made to the highest standard of excellence . . . They continue to be the choice of those who measure value by service rendered, and who seek the lowest cost per bearing per year of useful life . . . *Write for the Catalog. Let our engineers work with you. . . . . .*

NORMA-HOFFMANN
PRECISION BEARINGS
BALL, ROLLER AND THRUST
NORMA-HOFFMANN BEARINGS CORPORATION,
STAMFORD, CONN., U. S. A.

division. His present commission is that of lieutenant colonel. Technical society affiliations include the American Society of Mechanial Engineers.

♦ ♦ ♦

W. C. STEVENS, chief engineer of Cutler-Hammer Inc., Milwaukee, recently was elected a vice president in recognition of service. He has been with the company more than 25 years.

♦ ♦ ♦

W. L. BATT, president of SKF Industries Inc., Philadelphia, was installed as the new president of the American Society of Mechanical Engineers at its recent annual meeting. A picture and biographical sketch of Mr. Batt appeared in the Oct., 1933, issue of MACHINE DESIGN.

♦ ♦ ♦

CHARLES T. MAIN, Boston, past president of the A.S.M.E., was awarded the American Society of Mechanical Engineers medal for distinguished achievements in the textile and other industries and in engineering education, as well as for eminent services to the engineering profession.

♦ ♦ ♦

A. K. AUBECK, professor at the Royal Technical college, Copenhagen, was recently appointed president of the Danish Standardizing commission of the Ministry of Commerce and Industry of Denmark.

♦ ♦ ♦

C. C. HENNING is the recipient of the Robert H. Hunt award of the American Institute of Mining and Metallurgical Engineers. He is assistant general metallurgist of Jones & Laughlin Steel Corp., Pittsburgh.

♦ ♦ ♦

O. R. WIKANDER, chief engineer of Edgewater Steel Co., Oakmont, Pa., has been awarded the Melville medal for 1935 by the American Society of Mechanical Engineers. His paper on "Draft Gear Action in Long Trains" won him this mark of merit.

♦ ♦ ♦

J. HAROLD HUNT is the new engineering vice president of Motor Wheel Corp.

♦ ♦ ♦

L. S. MORSE, executive engineer, York Ice Machinery Corp., York, Pa., is the new president of the American Society of Refrigerating Engineers.

♦ ♦ ♦

JAMES H. HERRON, head of James H. Herron Co., Cleveland, and vice president of the American Society of Mechanical Engineers, recently was appointed chairman of the society's committee on professional registration and chairman of the advisory board on the professional status of the engineer.

♦ ♦ ♦

THOMAS W. PANGBORN, president of Pangborn Corp., Hagerstown, Md., recently was elected to his third successive term as president of the National Founders association. He long has been an outstanding figure in the foundry equipment field.

♦ ♦ ♦

HENRY A. WISE WOOD has been elected chairman of the board of directors of Wood Newspaper Machinery Corp. to relieve him of his administrative duties so that he can devote full time to research and development in the printing press field. He is succeeded as president of the organization

MEET THREE "TOUGH GUYS"

HERE'S WHY:

Three F-M motors power the spindle heads on this Sundstrand Rigidmil. It's a machine for a tough job, and Sundstrand demanded motors that were in keeping with the ability of their product to "take it."

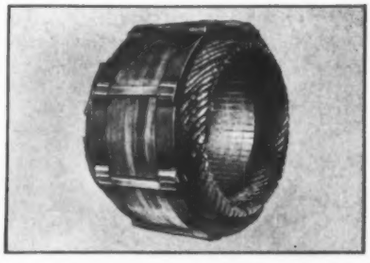
So they chose Fairbanks-Morse Motors!

MORE F-M MOTOR FEATURES

- Sealed-in ball bearings—"the highest priced ball bearings in the world"
- Group wound coils—from a single piece of wire
- Short, thick shafts
- Measured lubrication
- Heavily insulated vibration-proof stators
- One-piece rotor windings
- All internal connections welded
- Permanently plastic moisture-, oil- and acid-resisting insulation on all stator windings

LOCKED AND WELDED STATOR CORE—with laminations perfectly japanned and locked and welded under compression between sturdy stator heads. The only bolts and nuts used in the motor are those necessary to hold the bearings to the frame.

GROUP WOUND COILS—An entire phase group from a single piece of wire reduces lead connections—and these are WELDED, not soldered. This construction reduces the individual parts making up the prewound stator just as in the case of stator core.



No matter what your motor requirements may be, it *pays* to see what extra advantages Fairbanks-Morse Motors have to offer. For information, address Department D441, Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 Fairbanks-Morse branches throughout the United States are at your service.

6511EA40.95

FAIRBANKS-MORSE Motors

106 YEARS OF PRECISION MANUFACTURING

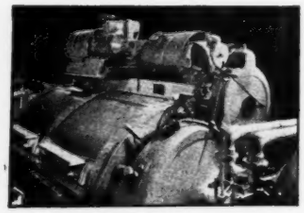
HELE-SHAW *Fluid* POWER

A NEW CONCEPTION OF FLEXIBILITY IN MACHINE DRIVES

NEWS FLASHES

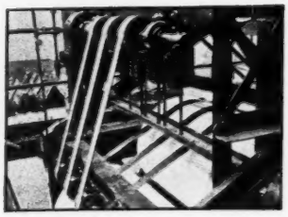
REVERSES LAUNDRY WASHER

A wash wheel usually makes 3 turns in each direction, requiring a motor to reverse itself 5 or 6 times a minute.



A Hele-Shaw Type C transmission was placed on this laundry washing machine over three years ago. It automatically reverses the wheel and has all the advantages of individual drive without the disadvantage of a reversing motor and panel board control. Laundry reports complete satisfaction from its use.

UNIFORM PERIPHERAL SPEED



As the diameter of a roll in a paper winder increases the peripheral speed must be held constant to prevent breakage. A Hele-Shaw Type S transmission delicately maintains constant tension by holding the peripheral speed uniform in the Castanea Paper Company, Lock Haven, Penna. Only the hydraulic motor "end" of the transmission is visible in the illustration.

TILTS CHARGING BOX

Edgar E. Brosius, Inc. of Pittsburgh have developed an unusual application for Fluid Power, using a Hele-Shaw pump for tilting the charging box of their Auto Floor Charger. This machine is used to charge open hearth furnaces and cupolas. Brosius engineers also apply Hele-Shaw Transmissions to billet manipulators and mud guns.

HUNDREDS OF APPLICATIONS

Any operation involving high pressure or variable, reversible linear or rotary motion is a potential application for Hele-Shaw Fluid Power. Our engineers, will be glad to help you determine its possibilities.

Send for Catalog F

AMERICAN ENGINEERING

AMERICAN ENGINEERING COMPANY

2502 Aramingo Avenue, Philadelphia

BEFORE YOU DESIGN, BUILD OR BUY MACHINERY, GET THE FACTS ABOUT HELE-SHAW *Fluid* POWER

by Oscar C. Roesen. A biographical sketch and picture of Mr. Wood appeared in the July, 1932, issue of MACHINE DESIGN.

♦ ♦ ♦

T. HOLLOWAY, who has been associated with United Engineering & Foundry Co., Pittsburgh, as gear consultant, has resigned.

♦ ♦ ♦

LEWIS M. LIND has been named acting chief of the machinery division of the bureau of foreign and domestic commerce. He succeeds R. E. W. HARRISON who resigned recently to enter private business. Mr. Lind was at one time connected with Lake City Malleable Co., Cleveland.

♦ ♦ ♦

AMBROSE SWASEY, one of the founders of the Warner & Swasey Co., and chairman of its board, celebrated his eighty-ninth birthday Dec. 19. He was honored at an informal luncheon at which the guests were given a demonstration of the 82-inch McDonald telescope and the process of polishing the mirror of this unit which is being built by the Warner & Swasey Co.

Obituaries

DEATH recently took E. W. Rice Jr., one of the pioneers of electrical development in the United States. In association with the late Charles A. Coffin he played a conspicuous part in the building of the General Electric Co., of which he was honorary chairman of the board.

Born seventy-three years ago in LaCrosse, Wis., Mr. Rice as a school boy came into contact with Prof. Elihu Thomson, then a teacher in Boys' Central high school. When in 1880 the professor gave up teaching to go into electrical manufacturing, as scientist and inventor, young Rice gladly accepted the opportunity to become his assistant.

The salient inventive achievements of his career included systems of distribution, particularly the cellular system of separating buses and circuits; synchronous converters, protective devices, arc and incandescent lamps, regulating systems and apparatus, etc. A picture and biographical sketch of Mr. Rice appeared in the January, 1932, issue of MACHINE DESIGN.

♦ ♦ ♦

EDWIN H. WHITNEY, who pioneered in the development of improvements of the early locomotive, died recently at Attleboro, Mass.

♦ ♦ ♦

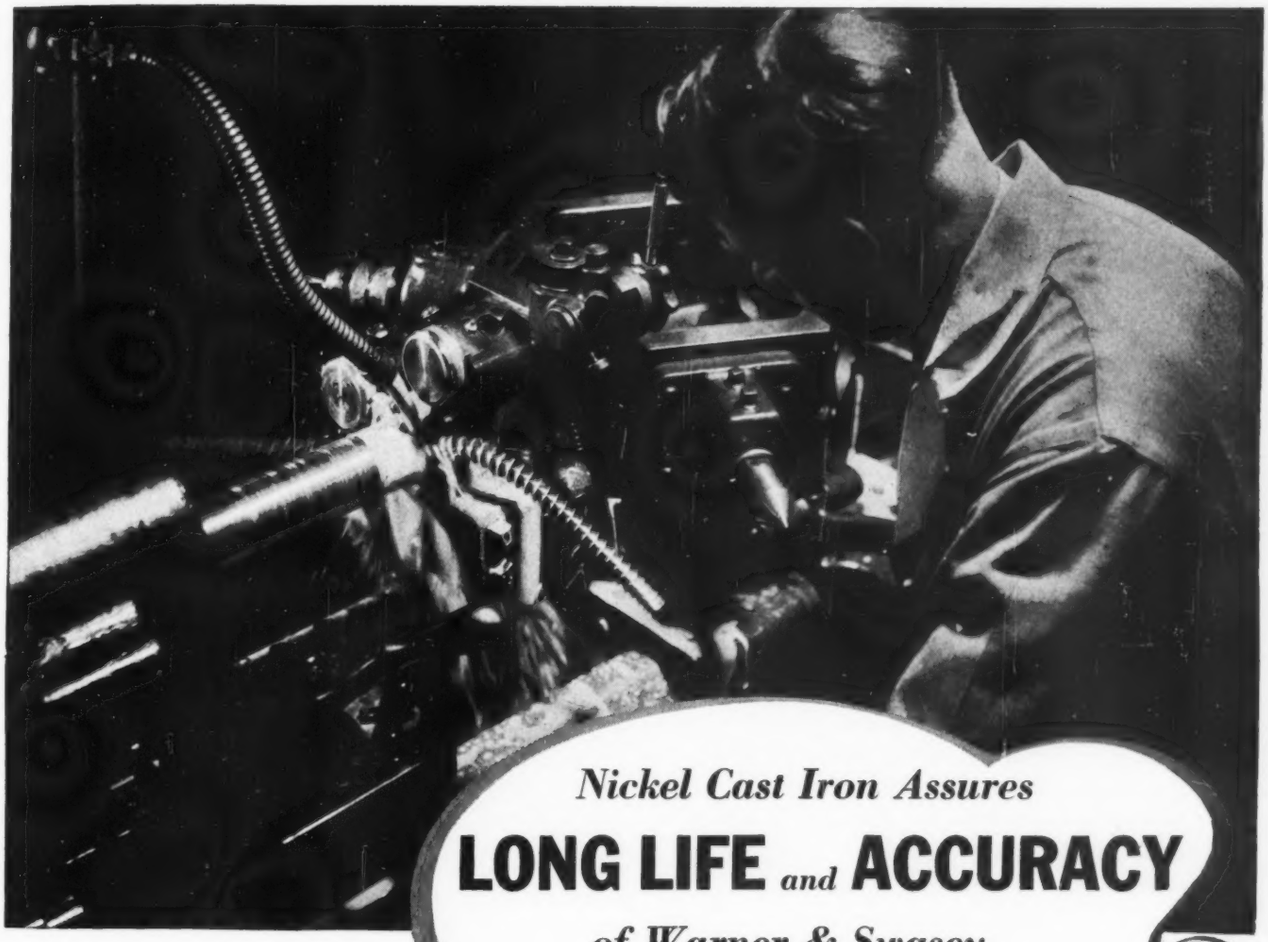
EDWARD HUGHES, chief engineer of Norge Corp., was killed in an automobile accident recently near Howell, Mich.

♦ ♦ ♦

LESLIE E. HOOKER, inventor of the extrusion process for manufacturing metal tubing, died recently at his winter home at San Mateo, Fla. He was in his seventy-eighth year.

♦ ♦ ♦

JOHN GOODMAN, professor of mechanical and civil engineering at the University of Leeds, England, died recently. He was widely known in this country through his textbook on mechanics applied to engineering, which went through nine editions.



Nickel Cast Iron Assures

LONG LIFE *and* ACCURACY

of Warner & Swasey Turret Lathes!

MODERN MACHINE TOOLS owe much of their superior power, speed and accuracy to the marked improvement in modern engineering materials . . . especially the alloys containing Nickel.

Warner & Swasey are liberal users of these Nickel Alloys and the following tribute to Nickel Cast Iron is quoted from a recent statement of President P. E. Bliss:

"The reputation that Warner & Swasey turret lathes have won over the past fifty years, can be attributed to the painstaking accuracy of our engineers and the high quality of workmanship and materials that go into these machines.

"Take the bed or base of these turret lathes for example. They must withstand all the stresses and strains imposed on the machine and maintain their original accuracy.

"In making our castings The Sterling Foundry Company, Wellington, Ohio, uses 1½% nickel to obtain a nickel high test iron made with an 80% steel mixture, attaining a very low carbon content and unusually fine distribution of graphite. And although these castings in certain instances have a hardness of 260 Brinell and a tensile strength as high as 50,000 pounds per square inch, they are readily machinable.

"These castings are exceptionally uniform in density or grain in all the variable thin and thick sections and are built to the maximum machinable hardness, producing a very fine finish. Without the use of your nickel we would be unable to obtain the same machinability, using the same base analysis. In consequence we claim definite high quality for our product through the use of your nickel."

• • •

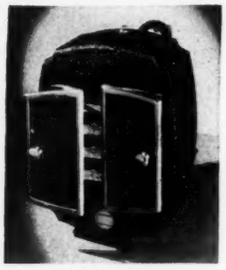
In addition to machine tool equipment Nickel Cast Irons are being used today with success and economy for a wide variety of castings . . . for internal combustion cylinder blocks, heads, liners and pistons; locomotive cylinders and parts; gears; cams; pump bodies, valves and parts; compressor parts; steel mill rolls; grinding, crushing and sizing equipment; plow points, mold boards, etc.

Our casting specialists will gladly cooperate in selecting compositions best suited to your requirements.

NICKEL CAST IRONS

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.
Miners, refiners and rollers of Nickel
Sole producers of Monel Metal

FINISHES



A SINGLE COAT!

a full, rich finish with S-W KEM ART METAL FINISH

McAleer steam and hot water automobile heaters are soundly engineered and handsomely styled. And being alert to practical ways to inject new life into their sales, McAleer specified S-W KEM ART METAL FINISH for these heaters because this finish fits hand in glove with today's production schedules — combining remarkable beauty and durability in a single coat job.

Available in colors picked for their popularity and suitability for different applications and styling trends — from bobbie pins to machines — S-W KEM ART METAL FINISH is proving the ideal product finish. It is applicable to almost any metal — stamped or cast — without the need for an undercoating. And its ability to hide the usual minor surface imperfections without costly surfacing makes this beautifully textured one coat finish a boon to manufacturers.

Write the Sherwin-Williams Co., Dept. M-20, Cleveland, Ohio, to find out what this and other S-W Finishes can do for your products.

SHERWIN-WILLIAMS

INDUSTRIAL FINISHES

Assets to a Bookcase

(*Concluded from Page* 33)

and steel casting; and wrought iron industries.

Group 2 deals with welding practice and technique, including welding apparatus. Group 3 treats the metallurgy of welding. Group 4 concerns specifications, inspection, testing, and safety aspects of welding.

Discussion has not been confined to particular methods, but much space is devoted to fusion welding, both by the electric arc and the oxyacetylene methods, since it is in the consideration of these that the most interesting problems arise in technique, in metallurgy, in testing and perhaps most important of all, in design. The information on these and kindred subjects is believed to be comprehensive.

Certain other aspects of welding have not been handled with the same completeness. No attempt has been made to include a full account of different types of plant or of particular processes. Similarly, the applications of resistance welding mentioned in the papers are not exhaustive. Treatment of these matters, where included, has necessarily been general, but more detailed analysis, it is believed, would not have brought to light new problems or elucidated further those which are discussed.

Only incidental mention has been made of the training of welders. The importance of adequate training is fully appreciated, but these volumes deal with materials and not with the men by whom they are handled.

□ □ □

Diesel Engineering Handbook

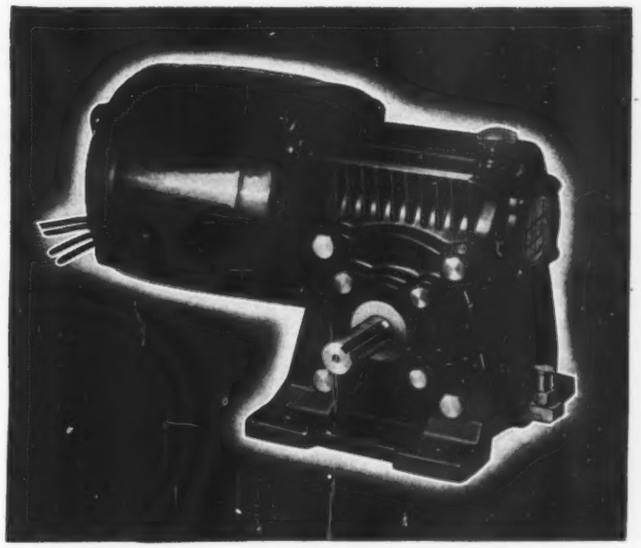
Edited by L. H. Morrison; published by Diesel Publications Inc., New York; available through MACHINE DESIGN *for* $5.00 *plus* 15 *cents postage.*

Few people realize that Rudolf Diesel was essentially a theorist and that the engine he actually patented was a "theory" engine. No working diesel engine has ever actually followed the cycle outlined by Dr. Diesel in his original patent claims. This fragment of historical data is taken from the opening chapter of the new deluxe *"Diesel Engineering Handbook,"* edited by L. H. Morrison. A tremendous fund of technical information has been assembled in the 840 pages of this volume.

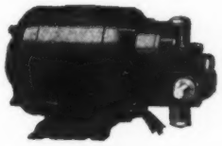
While the material was compiled with the potential diesel engine buyer and the user in mind, it does not leave the designer out of the picture. In fact, the design data included had to be comprehensive to make it the valuable handbook it is. With the widespread use of diesel engines and the increasing interest in the mechanical ideas they embrace, this book will find a place in many engineers' personal libraries.

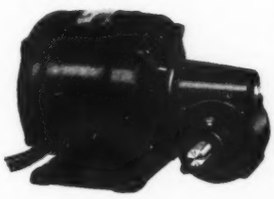
Now available—

a new Heavy-Duty SPEED REDUCER for Bodine fractional horsepower motors



Bodine engineers have just developed a new heavy-duty worm-gear speed reducer that is sufficiently rugged to easily transmit the full output of the one-sixth H. P. Bodine motor, with ample overload capacity. It can be used on Bodine split-phase, capacitor, and synchronous A. C. motors; and compound D. C. motors in the largest frame size. The new speed reducer is exceptionally strong, quiet in operation, and adaptable to almost any application.





Either the foot or flange mounting types can be supplied, each of which can be mounted to the floor, wall, or ceiling. Shafts can be extended from the gear box in either or both directions. If desired, a high speed shaft extension can be brought out.

•

Other Bodine Speed Reducer Motors

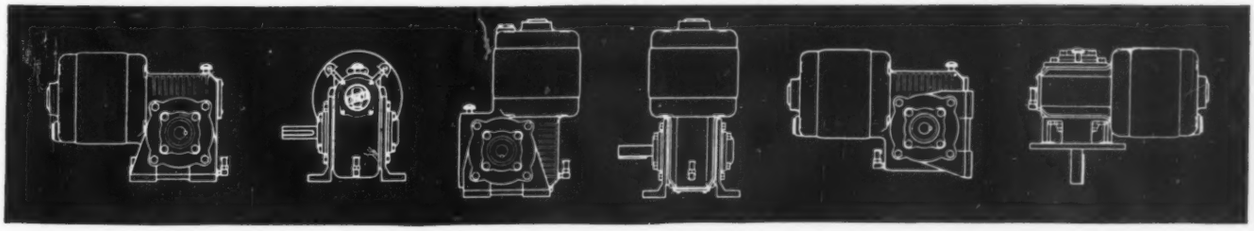
Bodine now offers a complete line of worm-gear speed reducer motors: three standard and three heavy-duty types. The standard duty units are shown at the left. This line includes a wide range of gear ratios and motors of practically all sizes and types. Let Bodine quote on your next slow-speed motor job.

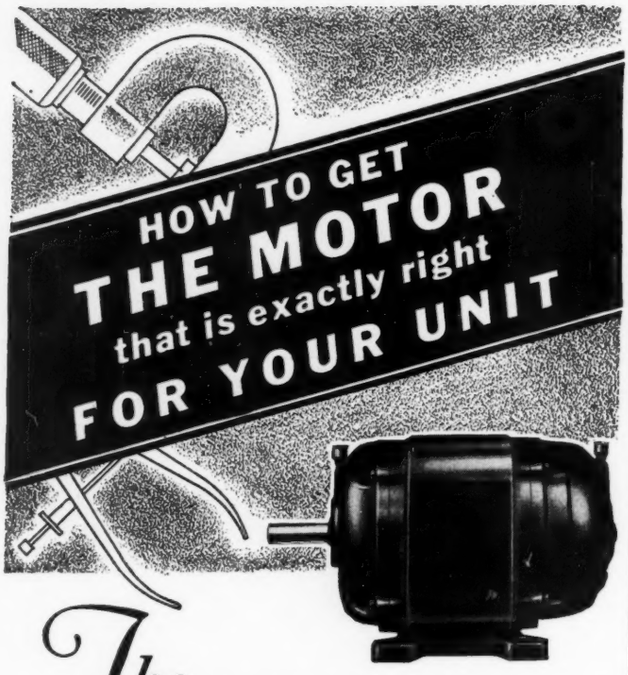
Check these important features:

- **ADAPTABLE**—Choice of motors, mounting positions, shaft extensions, and reduction ratios permits adaption of this unit to practically any machine.
- **RUGGED**—Will deliver the output of a ¼ H. P. motor but is used only with motors of ⅛ H. P. or less, providing generous overload capacity. Gear housing and motor end shield are cast in one piece. Heavy ball bearings support overhung as well as torque loads.
- **QUIET**—Worm-gear reduction unit designed for smooth and efficient operation. Worms are ground from hardened high carbon steel blanks. Gears are hobbed in the Bodine plant to unusually close tolerances. Worm and gear are run in together after assembly.
- **OIL TIGHT**—Oil provides proper lubricating film between worm and gear, regardless of mounting position. Sealed ball bearings, oil slingers, labyrinth seals, and packing eliminate all oil leakage.

Send for Catalog 2055-37

BODINE ELECTRIC CO.
2258 W. Ohio Street, Chicago, Ill.





The correct motor for your machine, tool or motor-driven equipment may require some entirely New Features . . . or special characteristics . . . not available in regular or stock motors.

Our facilities and production set-up are such that Special Motors are designed, tested and produced in large or small quantities in the minimum of time—and our guarantee of satisfactory performance goes with each one. Prices are in line, too.

WRITE

Latest Bulletins containing complete Technical Data on motors, specifications and other helpful information, sent upon request.

The* BALDOR *Line Includes:

SINGLE PHASE—Repulsion Induction	⅛ to 7½ H. P.
Capacitor Type	1/30 to 1½ H. P.
Split Phase	1/30 to ½ H. P.
DIRECT CURRENT	⅛ to 3 H. P.
POLYPHASE—Squirrel Cage	⅛ to 15 H. P.
Double Squirrel Cage	3 to 15 H. P.
UNIT HEATER MOTORS—All Types	1/30 to ½ H. P.

Standard Horizontal and Vertical Motors for all applications.
Ball Bearings in all sizes. Sleeve bearing up to 2 H. P.

BALDOR ELECTRIC COMPANY
4352 Duncan Avenue, ST. LOUIS, MO.
Sales and Service Offices in Principal Cities

BALDOR
A BETTER MOTOR

Noteworthy Patents

TO CUT paper tubes such as soda straws in predetermined lengths as they move continuously forward obviously requires compound movement of the parts employed in the operation. How this is accomplished with a simple mechanical arrangement is disclosed by a newly-patented machine. Moreover, the unit produces the tubes from strips of paper, this process being carried out on a winding mandrel *A* that is driven by an endless belt *B* as shown in *Fig.* 1. The two strips of paper in the form of rolls are carried on bracket *C* and fed to the mandrel at an angle opposite to that of the belt, as practiced in the art, with one of the strips of paper in contact with a glue drum.

As the strips are formed into spiral tube *D* it enters into the receiving end of guide *E*, *Figs.*

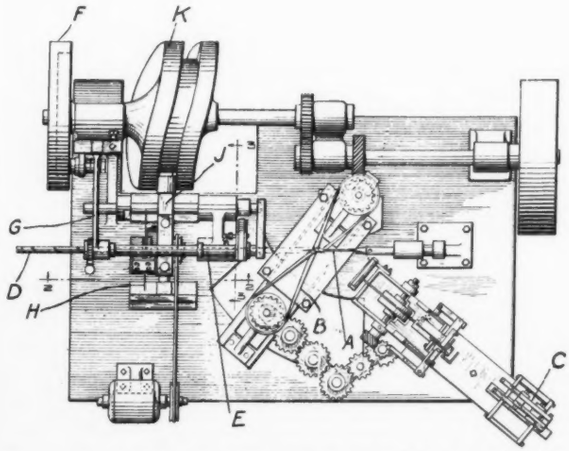


Fig. 1—*Two strips of paper fed at an angle to a winding mandrel are rolled spirally into soda straws*

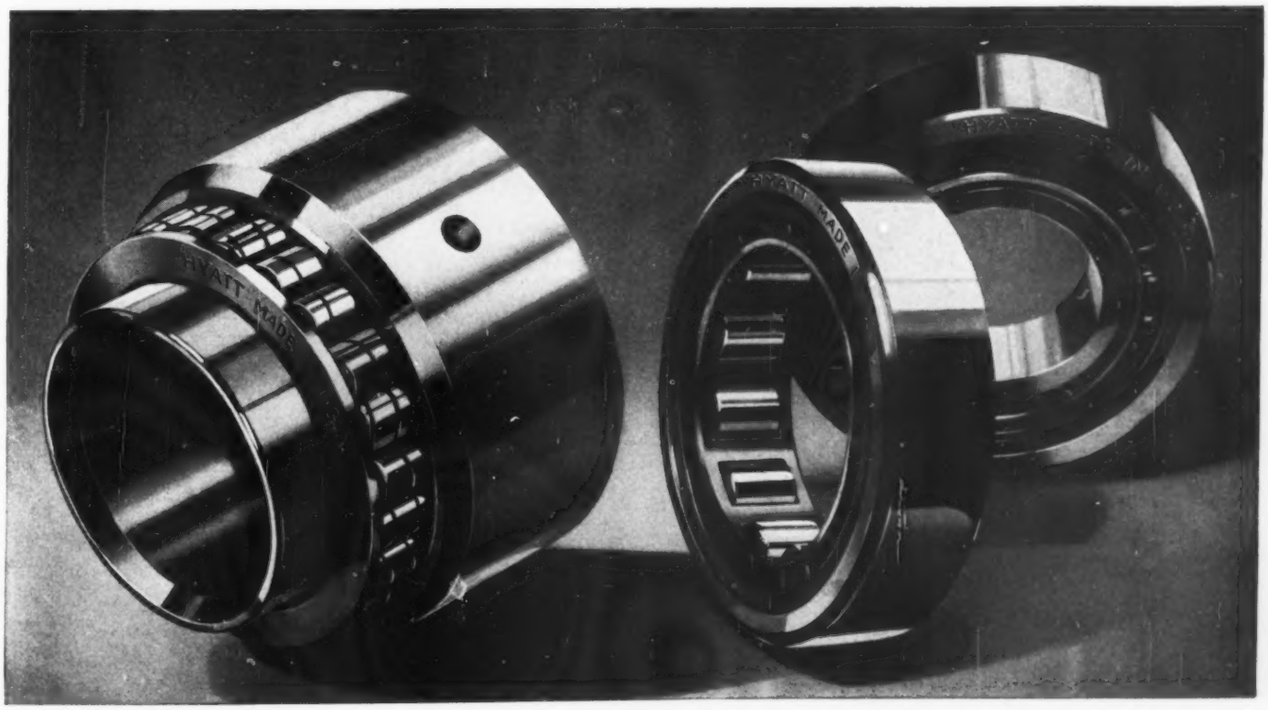
More and More HYATTS *are going places . . .*

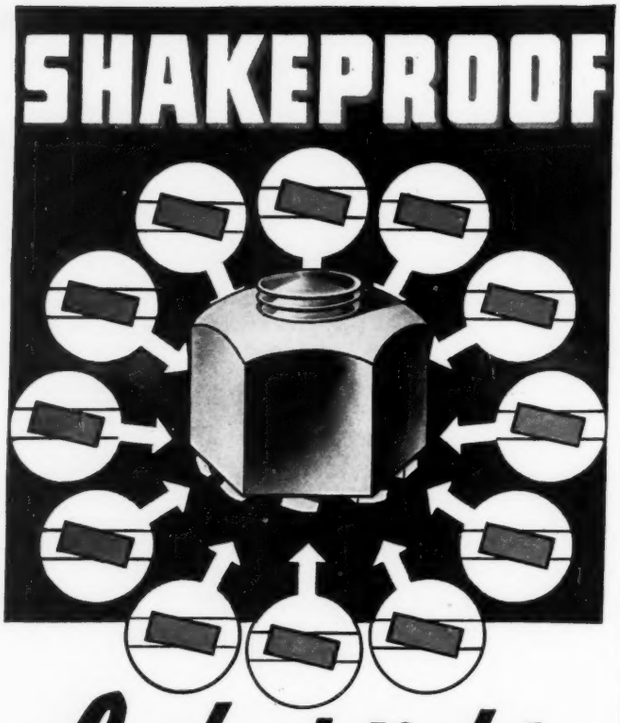
The smoother running, carefree, power saving advantages of Hyatts are well known in every field they serve. And of equal importance is the ability of Hyatt Roller Bearings to prolong their own life as well as the life of related parts. That's why there are more and more Hyatts used in the vital operating parts of equipment . . . The equipment builder's pledge of better design and the user's assurance of better operation. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, San Francisco.

H Y A T T

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

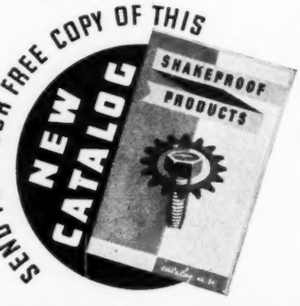




Locked tight-

ALL THE WAY 'ROUND!

If you are anxious to protect the performance of your product from the damaging action of vibration, you should seriously consider using Shakeproof Lock Washers under every nut and screw. This multiple locking washer provides a positive force against any backward movement of the nut which keeps each connection absolutely tight. Each twisted tooth bites into both nut and work surfaces and, as vibration increases, the teeth bite in deeper. Test this modern lock washer on your own product—see its action with your own eyes—send for free testing samples today!



SHAKEPROOF
Lock Washer Company

Distributors of Shakeproof Products
Manufactured by Illinois Tool Works

2551 N. Keeler Ave. **Chicago, Ill.**

U. S. Pat. 1,419,564—1,604,122—1,697,954—1,782,387—Other Pat. Pending—Foreign Pat.

1 and 2. Cam *F, Fig.* 1, swings arm *G* up and down, this dipping operation being imparted to the tube guide which is also swung laterally by the spur gear and rack arrangement depicted in *Fig.* 2.

Circular knife *H* is mounted on a spindle carried by a bearing formed as part of a carriage *J* reciprocated by cam *K*. The straw is lowered and swung forwardly to maintain it in contact with lip portion *L* of a platen during the presentation of straw to the knife. Knife and lip portion form a converging wedge shape, with the knife rotating in a direction toward the apex. Consequently, the straw which travels on one face of the wedge and rotates with

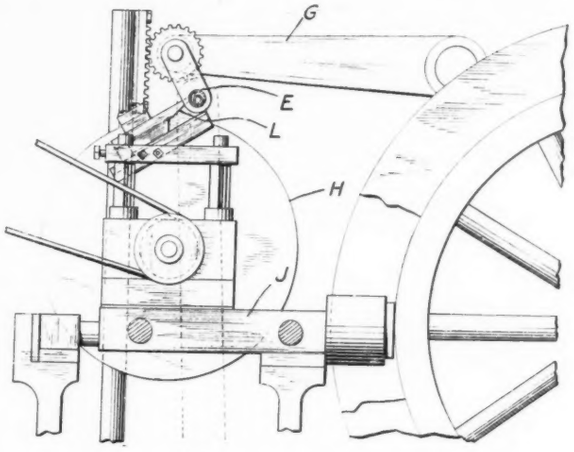


Fig. 2—A circular knife controlled by a cam cuts the paper tubes into predetermined lengths

peripheral contact in the direction of movement of the periphery of the knife is engaged by the knife and cut with more certainty and less distortion than if the movement of the straw were at a right angle to the direction of movement of the cutting edge.

The patent, designated No. 2,013,303, is assigned to Soda Straw Mfg. Corp., Newark, N. J.

USE of hydraulics in a continuous cutter type mining machine provides a wide range of feeding speeds that can be regulated closely. The transmission mechanism, *Fig.* 3, covered by new patent No. 2,015,143, is driven by an electric motor, the armature shaft *A* of which drives shaft *B* through gearing as indicated in drawing *X*. Manual manipulation of nut *P* will position the portion *K* of valve *F* to the right of the position shown in drawing *Y*, so that the mouths of passages *L* then will be slightly open.

Shaft *B* will cause housing *C* to rotate counterclockwise and accordingly pinions *D* (drawing *Z*) will roll around within an internal gear

QUIET

STARTING

Here's good news about noise—of particular value to users and manufacturers of Air Conditioning and other Service Equipment—where quiet is always an important factor!

When the New Century Polyphase Motors start, there is a conspicuous absence of the usual grunting, singing and whistling noises!

This substantial noise reduction has been achieved by new, improved features of design . . . Proof on request.

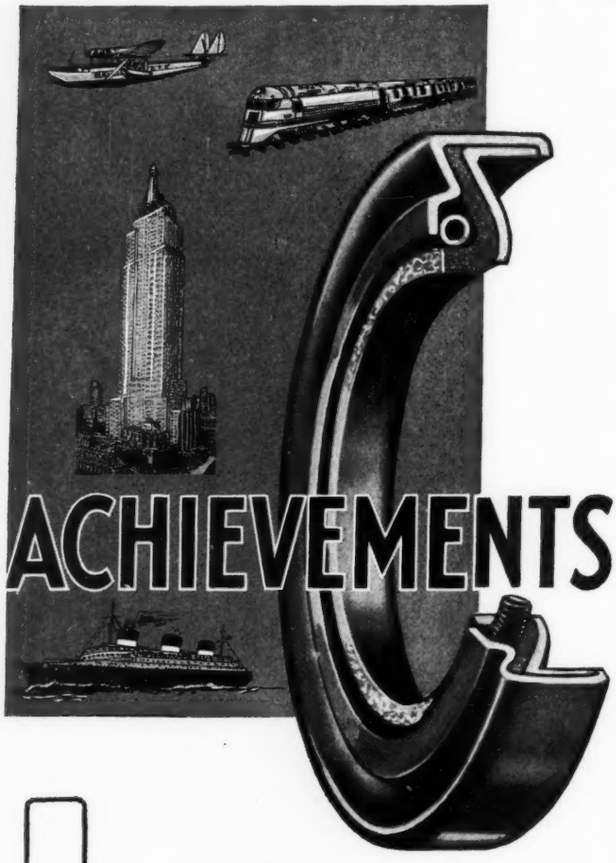
Another distinct contribution by Century!

CENTURY ELECTRIC COMPANY
1806 Pine Street , , , St. Louis, Mo.
Offices and Stock Points in Principal Cities

Century MOTORS

UP TO 600 HORSEPOWER

OUTSTANDING



ACHIEVEMENTS

Milpaco Oil Seals rank with the outstanding achievements of 1935. Characteristic design and construction establish them as unusual.

Details of design and construction in Milpaco Oil Seals—some very minute—make them more effective sealing and protective units, and give them longer life in active service.

Exact chemical and physical processes applied for every kind of application, qualify Milpaco Oil Seals for specific conditions.

Intensive research, laboratory and field tests, have disclosed some mighty interesting facts about Milpaco Oil Seals in Every Type of Industry

Our technically trained engineers have an unusual amount of scientific knowledge on the subject of oil seals and applications, at their command.

The opportunity of finding out what Milpaco Oil Seals are, and what they actually do in service, is yours for the asking. Just have one of our engineers call. Your time will be spent profitably.

MICHIGAN LEATHER PACKING CO.
724 Fourteenth Ave., Detroit

S-107

MILPACO

E. If this gear remains stationary, it is evident that a vacuum will be produced to the rear of each of the pinions *D*, and accordingly oil will be drawn from a sump up into the hollow valve *F* (drawing *Y*) and pass by way of certain of the passages *G* to an annular groove and thence to the passages *H* in the member *C* and into the spaces *J* at the rear of pinions *D*.

Rotation of the pinions also will serve to force fluid out from the portion of spaces *J* in advance of the pinions, finally filling all spaces between members *C* and *E* with oil. The machine then will feed at full speed simply by moving the spool or head *K* to a position to close the mouths of passages *L*. Obviously, since no fluid then can be displaced from portions of spaces *J* in advance of pinions *D*, these pinions cannot rotate. They therefore will lock

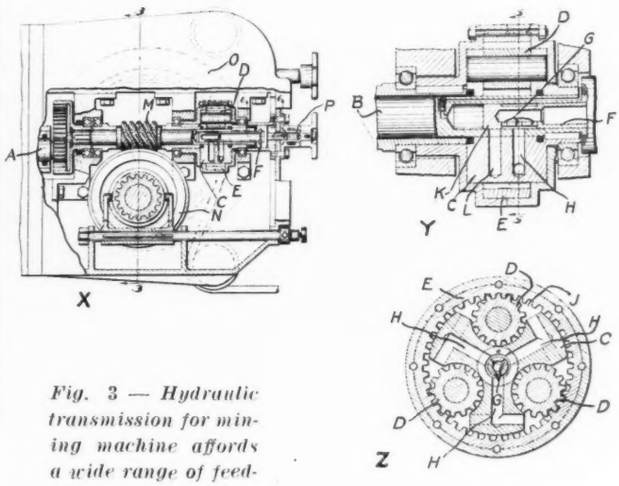
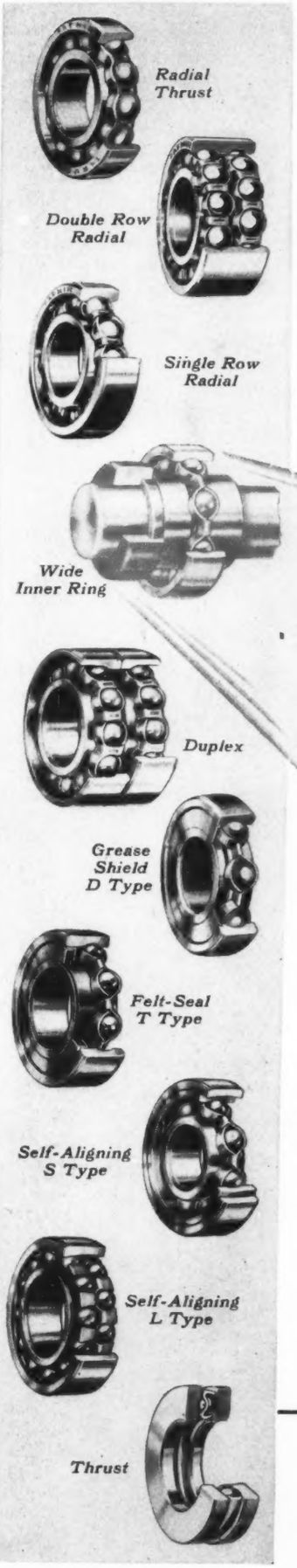


Fig. 3 — Hydraulic transmission for mining machine affords a wide range of feeding speeds, permitting close regulation

with internal gear *E* and cause rotation of the latter to drive worm *M* at the same angular speed as shaft *B*. If a slower speed is desired, valve *F* may be shifted further to the left (drawing *Y*) and a controlled flow of fluid to the rear of the pinions *D* will be permitted. With rotation of worm *M*, drive of worm wheel *N* (drawing *X*) will be effected, and by lowering a clutch the feed operating member *O* will be driven.

The patent is assigned to Sullivan Machinery Co., Chicago.

ONE of the problems in designing refrigerating apparatus is encountered in sealing the shaft opening in a fluid chamber such as the crankcase of a compressor. It has been believed necessary to use an extremely heavy spring to

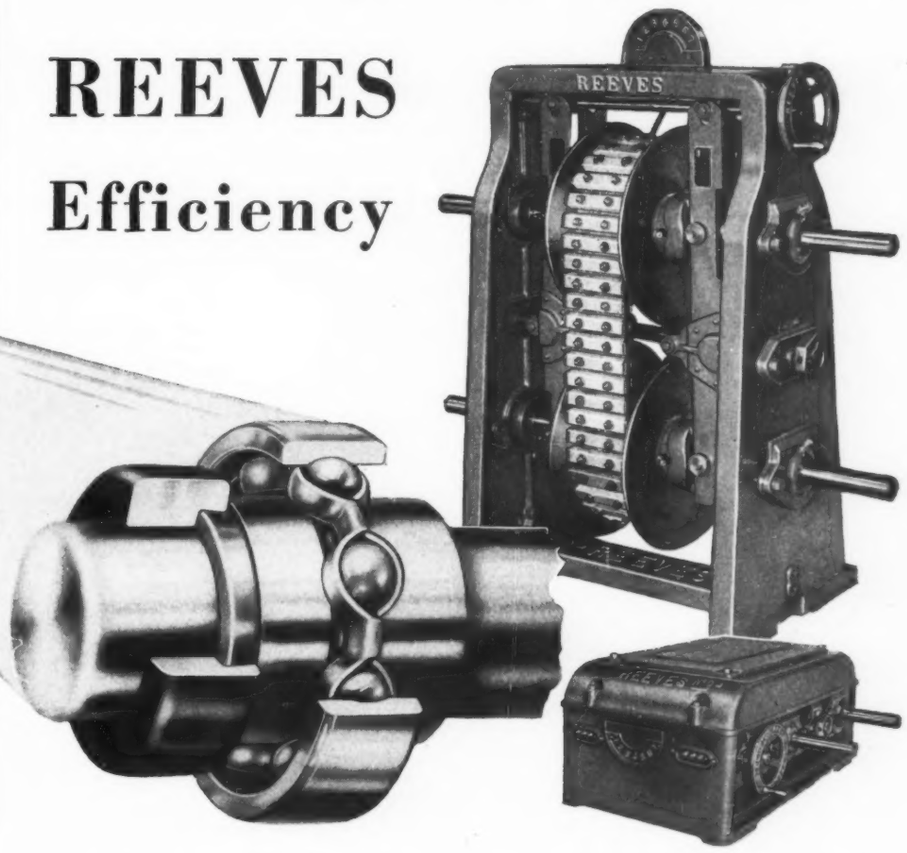


FAFNIR BEARINGS

... an important factor in

REEVES

Efficiency



Fafnir Ball Bearings are one of the important factors in the high efficiency rating and long life of the REEVES Variable Speed Transmission — the compact, mechanical speed control unit which maintains positiveness and accuracy at all desired speed settings.

Four Fafnir Wide Inner Ring Type Bearings Units are incorporated in every REEVES Transmission, supporting the two shafts where they pass through the frame and absorbing the radial load. Reducing friction losses at these points to a minimum, these bearings enable REEVES to transmit an unusually high percentage of the power it receives to the driven machine at infinitely adjustable speeds over ratios from 2:1 to 16:1.

More than 200,000 Fafnir Bearings have been used in REEVES Transmissions. Fafnir's specialized engineering service, plus "the most complete line of ball bearings in America", makes it possible to provide the one bearing best adapted to a given service wherever power is transmitted. THE FAFNIR BEARING COMPANY, *New Britain, Conn.* Atlanta . . . Chicago . . . Cleveland . . . Dallas . . . Detroit . . . Kansas City, Mo. . . . Milwaukee . . . Minneapolis . . . New York . . . Philadelphia.

WORTHWHILE *economies in design and production are given in every issue of Fafnir's house organ,* "THE DRAGON". *We will gladly add your name to the mailing list.*

FAFNIR
BALL BEARINGS

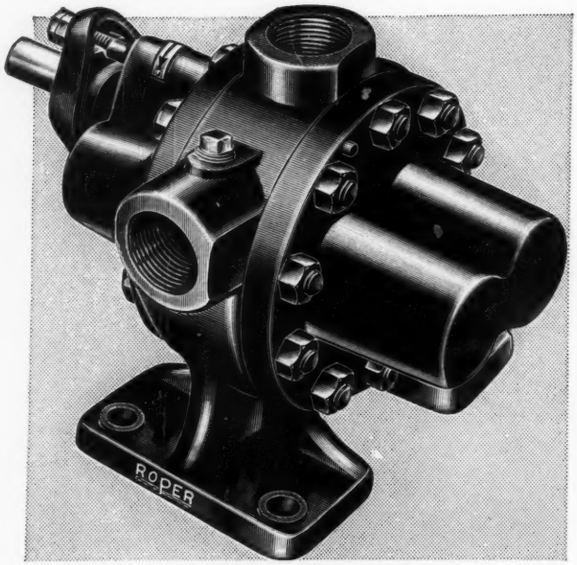


Fig. 999

ROTARY PUMPS

for Hydraulic Power Applications

- ***Full Ball Bearing Design***

909 Series—Capacity, 10 to 50 G.P.M. (larger capacity if required). Pressure, 750 lbs.

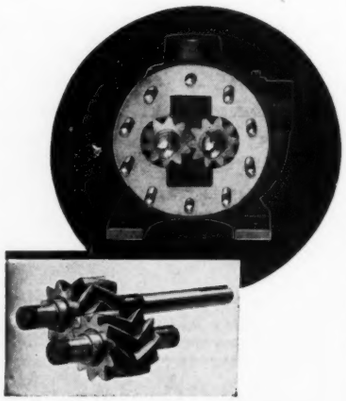
996 Series—Capacity, 4 to 200 G.P.M. (larger capacity if required). Pressure, 300 lbs.

- ***Sleeve Bearing Design***

997 Series—Capacity, 80 to 700 G.P.M. Pressure, 100 lbs. (lubricating liquids) 40 lbs. (non-lubricating liquids).

999 Series—Capacity, 1 to 500 G.P.M. Pressure, 100 lbs.

- **Equal size gears operate at same speed.**
- **Accurately hobbed gears keyed and pressed on to shafts.**
- **Extra long large bearings.**
- **Carefully machined case.**
- **Rugged cast-iron construction.**



Write for Bulletin R5MD

GEO. D. ROPER CORP.
ROCKFORD, ILLINOIS, U.S.A.

ROPER *Rotary* PUMPS
DEPENDABLE - SINCE 1857

hold the sealing ring upon its seat and prevent leakage. In most cases the pressure of the seal upon the seat is further increased by the pressures within the crankcase, causing increased wear.

In the newly patented seal, *Fig.* 4, the forces resulting from crankcase pressure will be balanced since the outer diameter of the sealing surface *A* is equal to the annular center of pressure of bellows *B*, designated as *Dm2*. Pressure surrounds bellows *B*, the recess communicating with the crankcase by means of oil passage *F* and bearing *G*. Since in this form the sealing ring has a narrow sealing surface or seat, the seal will be substantially balanced against atmospheric pressure, but there is a small unbalanced area which is equal to the area of the seat and upon which atmospheric pressure is exerted that will tend to hold seal-

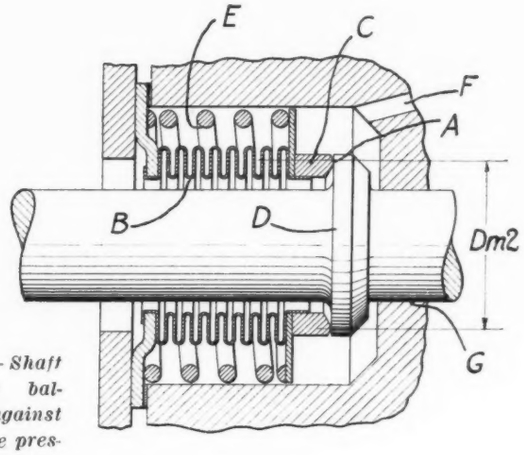


Fig. 4 — Shaft seal is balanced against crankcase pressure to prevent escape of refrigerant

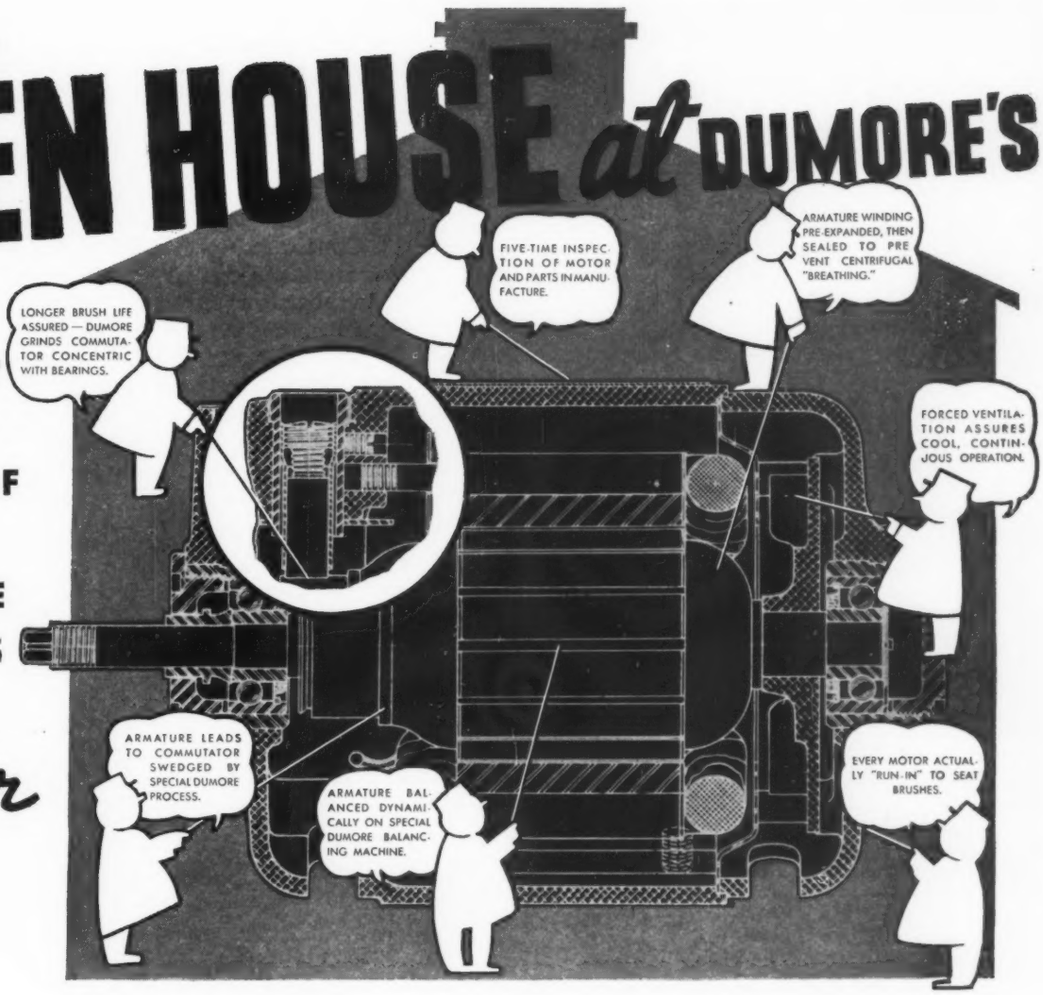
ing ring *C* against shoulder *D*. This force, however, is comparatively small because of the small area of the sealing surface. With a narrow seat a perfect contacting surface can be more easily obtained. Coil spring *E* provides an added seating pressure for the sealing surfaces. It has been found that the seat is properly maintained without the use of the spring, but it is employed because of the variations in resiliency and flexibility of the manufactured bellows.

General Motors Corp. is assignee of this patent, designated No. 2,010,930.

AUTOMATICITY attained in the design of a multiple record phonograph that has been patented recently merits attention. Upon completion of a record, tone arm *A*, *Fig.* 5,

It's OPEN HOUSE at DUMORE'S

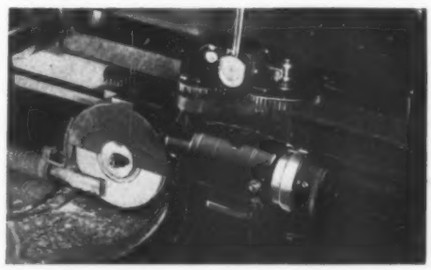
Now SEE FOR YOURSELF WHY DUMORE MOTORS ARE Better


LONGER BRUSH LIFE ASSURED — DUMORE GRINDS COMMUTATOR CONCENTRIC WITH BEARINGS.
FIVE-TIME INSPECTION OF MOTOR AND PARTS IN MANUFACTURE.
ARMATURE WINDING PRE-EXPANDED, THEN SEALED TO PREVENT CENTRIFUGAL "BREATHING."
FORCED VENTILATION ASSURES COOL, CONTINUOUS OPERATION.
ARMATURE LEADS TO COMMUTATOR SWEDGED BY SPECIAL DUMORE PROCESS.
ARMATURE BALANCED DYNAMICALLY ON SPECIAL DUMORE BALANCING MACHINE.
EVERY MOTOR ACTUALLY "RUN-IN" TO SEAT BRUSHES.

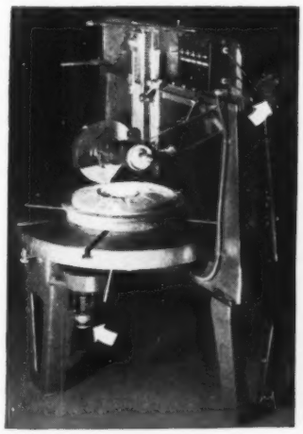
Beneath the housing of a motor there's much that's never seen. You're taking a big chance when you buy a motor from its outside appearance or cost. Look into the construction. There are no secrets about what Dumore has to offer.

Dumore's compact construction and precision manufacturing methods insure more "power-hours"— a smoother flow of power, day after day — years longer. *You don't just buy a "stock" motor* — you secure the benefits of 22 years experience in the application of power. Your particular adaptation is treated individually.

The handy Dumore catalog shows you a complete line of Universal (series wound) motors in horsepower from 1/100th to 3/4 — in voltages from 6 to 250 — a range of speeds from 4 to 20,000 r.p.m. (through electrical governor on all sizes and speed reducers on 1/6th h.p. or less). Mail the coupon for your copy.



Views show one of Buhr-stone grinding machines in plant of U. S. Gypsum Co. Designed by Nelson Bros. & Strom, Racine, Wis. The varying speeds required are obtained by electric governors on the Dumore Motors—controlled by a "twist of the wrist."



SERIOUS PROBLEMS OF PAINT INDUSTRY SOLVED

Scarcity of skilled artisans for dressing pigment-grinding buhr-stones has been offset by this triple-action machine whose feed controls are driven by three Dumore motors. It resurfaces, bevels and makes grooves of tapering depth with greatest accuracy. Another of many Dumore adaptations.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

THE DUMORE CO. *Dept. 125-a*
Racine, Wis.
Send me your latest catalog of Dumore fractional h. p. (series wound) motors.
*Name*_____ *Title*_____
*Firm Name*_____
*Address*_____
*City*_____ *State*_____

UNBRAKO

UNBRAKO HOLLOW SET

AFTER a great many years on the market the "UNBRAKO" is still among the top-notchers or in other words: None is better.

FREE SAMPLES OF BOTH SET & CAP

KNURLED UNBRAKO

All mechanics use their fingers driving Screws. Knurls gear fingers to head; fingers, therefore, have better purchase, drive faster and further.

Pliers bite the Knurled "Unbrako," but slip on Smooth-Heads.

Ask how we lock the Knurled "Unbrako" when countersunk – it's unique.

The Knurled "Unbrako" looks trim and attractive and dolls up any piece of machinery.

U. S. & Foreign Pats. Pending

ORDER BY NAME—SPECIFY THE KNURLED "UNBRAKO"

STANDARD PRESSED STEEL CO.

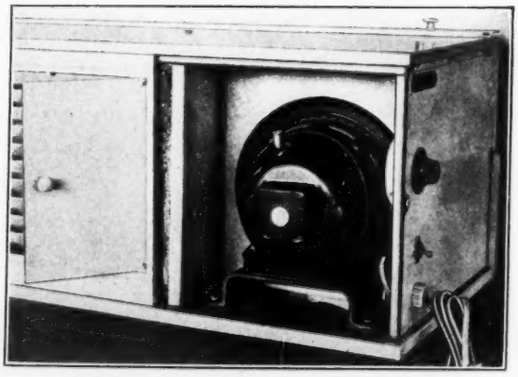
BRANCHES BOSTON CHICAGO DETROIT

JENKINTOWN, PENNA. BOX 102

BRANCHES NEW YORK SAN FRANCISCO ST. LOUIS

MOTORS BUILT TO FIT THE JOB

FOR AIR CONDITIONING UNITS



QUIET • RUGGED • DEPENDABLE

Manufacturers of motor driven apperatus and appliances have found Holtzer-Cabot Motors built to fit the job, give best results. Our engineers have a wealth of experience. Let them shoulder your motor problems.

Write us regarding your requirements—Dept. 14

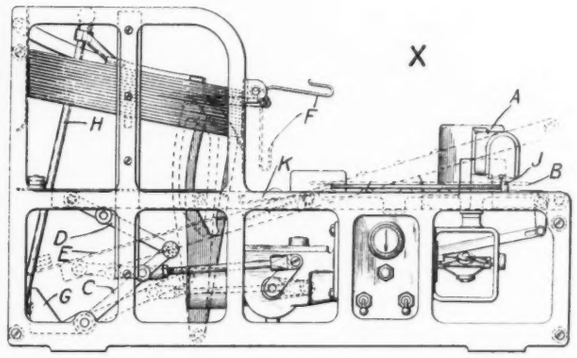
HOLTZER-CABOT ELECTRIC CO.

125 AMORY ST. BOSTON, MASS.

MOTOR SPECIALISTS

swings out, thus closing a switch and energizing a solenoid. This causes engagement of a clutch and rotation of a shaft which breaks the toggle *C, D,* to move the tilting table *E* to the position shown in the dotted lines in drawing *X*. As soon as this position is assumed, record *B* slides down to the lower end of the transfer table.

Continued operation of the mechanism straightens out the toggle to move the table to the position shown in drawing *Y*. This positions the played record beneath the stack of records. Prior to this stage in the movement of the table, a record had been placed in hooks *F* through operation of cam *G* which rotates *H* to push a record from the stack into the hooks. As the table moves up to the position depicted, the



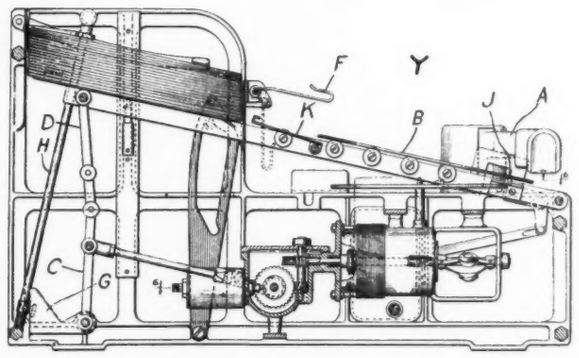


Fig. 5—Automatically-controlled tilting table transfers records to and from playing mechanism

record is swung down and as the table moves up the record is inverted and positioned on the table. The hooks on plate *K* engage the lower edge of the record and assist in lifting it out of hooks *F*. Subsequently, the record slides down the table into playing position which is determined by stops *J*. The tone arm then is restored to playing position to complete the cycle.

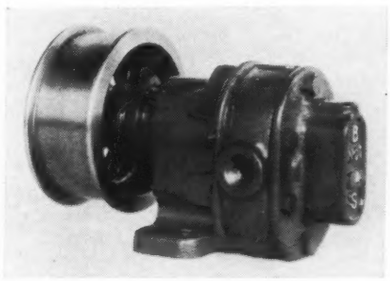
Automatic Phonograph Corp., Newark, N. J., is the assignee of this patent identified as No. 2,013,927.

NEW *Materials and Parts*

Helical Geared Pumps Announced

ROTARY geared pumps with helical gears in a new series, known as No. 1S, No. 2S and No. 3S, have been introduced by Brown & Sharpe Mfg. Co., Providence, R. I. The helical gears in the pumps, which operate smoothly and quietly, permit higher speeds than the former designs with spur gears and make the pump available for a direct drive for ordinary motor speeds. These pumps also have renewable bronze bearings which provide for easy replacement.

Intended primarily for use with comparatively clean liquids, these pumps are particularly suited for pumping clean oil, oil emulsion, soda solution, etc. They are especially advantageous for cooling installations where quietness is essential at motor speeds and where precautions are taken to keep chips from the pumps; also for light hydraulic operations the helical gears insure a steady flow of oil without pulsations.



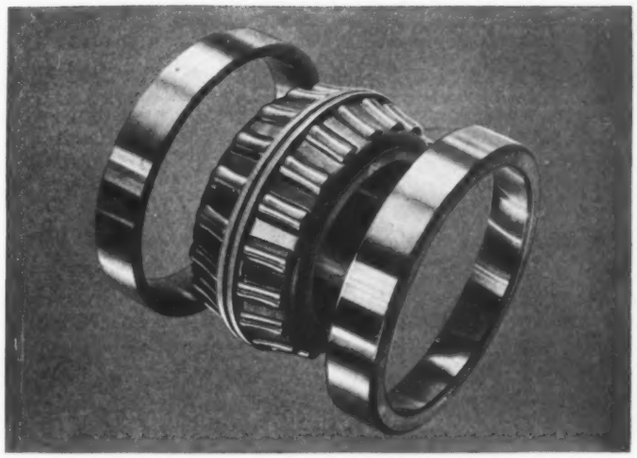
Rotary geared pumps provide quietness at motor speeds for built-in applications

Pumps run in either direction; discharge is on the side of the pump toward which the top of the pulley rotates. The units will raise oil on suction side a distance of 25 to 35 feet with tight piping and at speeds above 1000 RPM.

Introduces Worm Gear Reducers

CUT-TOOTH worm gear speed reducers of simple, compact construction in a new line are being manufactured by Link-Belt Co., Philadelphia. The new reducers, shown herewith, are available in a wide range of ratios and capacities, with single or double reduction, and in horizontal and vertical types; all provided with tapered roller bearings and automatic lubrication within dustproof gray iron housings.

The output shaft with its chilled phosphor bronze worm wheel can be located above or below the worm shaft, which is made of a low carbon alloy steel forging, carburized and heat



The **IDEAL BEARING**
for Radial-Thrust Loads

Note that the exclusive Shafer CONCAVE roller design carries both radial and thrust loads by direct full-area contact of the rollers and raceways only.

Generous capacity for combined loads is always available, always fully effective. The inherent Shafer self-alignment maintains free rolling action even in the presence of shaft deflection and misalignment.

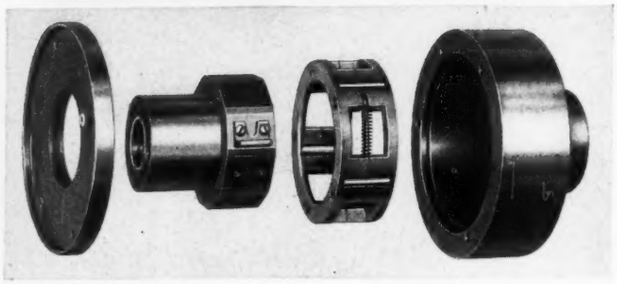
Only Shafer combines: 1—Radial-thrust roller bearing capacity. 2—Integral self-alignment, within the bearing itself. 3—Simple adjustability.

Catalog 12 gives complete data on Radial-thrust Roller Bearings, Pillow Blocks, Hanger Boxes, Flange Units, Take-up Units, Cartridge Units, Duplex Units, Conveyor Rolls.

★ **SHAFER BEARING CORPORATION**
6513 West Grand Avenue Chicago, Illinois

SHAFER
self aligning
ROLLER BEARINGS

free-wheeling in drive design



HILLIARD OVER-RUNNING CLUTCHES

COMPLICATED driving mechanisms attached to most modern day lay-out can now be simplified with the application of the *Hilliard Over-Running* (Free Wheeling) *Clutch* —serving as either clutch or coupling.

Particularly suitable for dual drives, two speed drives and as a ratchet having an infinite number of settings and no backlash.

Its long wearing, trouble-free life is dependent upon its extreme simplicity and the use of oil-hardened high carbon steel, ground to size, for the inner members, rollers and outer ring—shown in illustration.

Suggestions and estimates may be yours without obligation. Ask for Bulletin 103-D.

Clutches for Every Purpose

THE HILLIARD CORPORATION
ELMIRA, N. Y.

Clutch Makers for Thirty Years

Now- Higher Speeds
up to Usual Motor Speeds
. . . with Quietness
Long Life
Efficiency
—the New Nos. 1S-2S-3S
ROTARY GEARED PUMPS
with Helical Gears

May we send details?
Brown & Sharpe Mfg. Co.
Providence, R.I.

Brown & Sharpe Pumps
Geared — Vane — Centrifugal

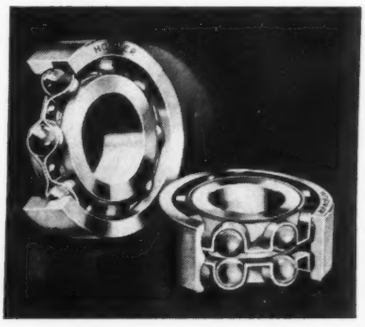
treated after the worm threads have been cut. A feature of the double reduction reducer is the unitized attachment of primary reduction unit to the side of final reduction housing.

Conforming with the recently recommended practice of the American Gear Manufacturers association, the name plate of each worm reducer is stamped to indicate the ratio, input and output RPM, the input horsepower or output torque capacity, and the service factor used in determining the rating for which the unit has been sold.

Output shaft of worm gear speed reducers can be located above or below the worm shaft

Antifriction Bearing Line Increased

SEVENTY-FIVE new sizes of radial and angular contact type ball bearings have been added to the line of ball and tapered roller bearings manufactured by Hoover Steel Ball Co., Ann Arbor, Mich. These additions embrace both the single and double row types all of which are made in keeping with SAE and U. S. Navy department specifications covering design, tolerance, materials, etc. Also, numerous special sizes and types of bearings are being added to the line for specific applications in the passenger car, truck and tractor fields.



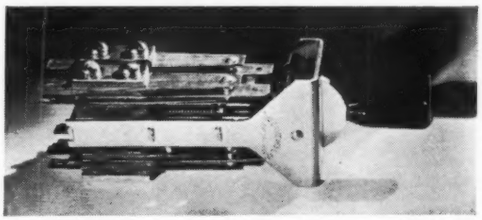
Additions to radial and angular contact type ball bearings embrace both single and double row types

Single row bearings will include all sizes from

No. 200 to No. 222 in the light series; No. 301 to No. 318 in the medium series and No. 404 to No. 410 in the heavy series. Double row bearings will include all sizes from No. 5202 to No. 5210 in the light series and No. 5302 to No. 5312 in the medium series. Both single and double row bearings will be available with one or two lubra-seal plates as well as the standard types of bearings.

Switch Utilizes Stainless Steel

DESIGNED for use in circuits where the break-down requirements do not exceed 2500 volts, a new-type cam lever switch is being introduced by Gamewell Co., Newton, Mass. Contacts of the switch, shown herewith, are rated at 1 ampere, 110 volts, direct current noninductive load. A positive stop is provided in the center position so that when the handle is returned to this position from an operated position the contacts on the opposite side of the switch are not affected. There is approximately 1/16-inch between the rollers and the operating springs when the switch is on the center position.

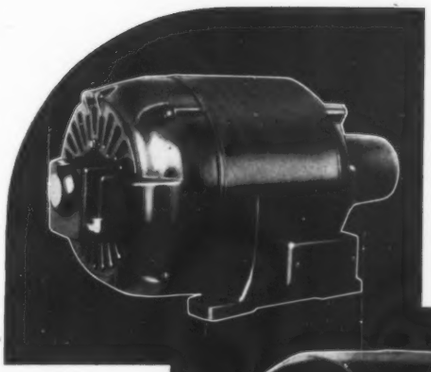


Rollers in new type cam lever switch are attached to a stainless steel cam

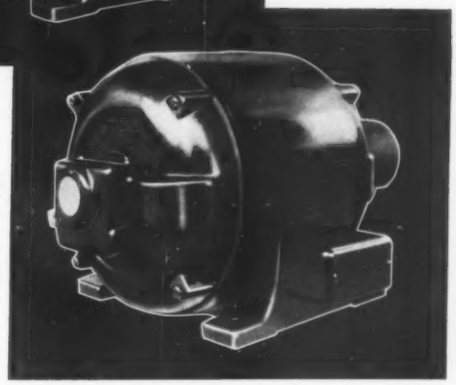
In the construction a stainless steel cam is provided to which are attached the required number of rollers which control the operation of the operating springs. A roller is provided for each spring. The springs are a complete assembly in themselves so that they may be removed from the frame by removing two screws and the strap without changing the settings of the springs or contacts. Contact springs are made of tinned phospher bronze.

Introduces High Tensile Steel

A NEW steel, known as Hi-Steel, with a minimum yield point of 60,000 pounds per square inch for gages lighter than ¼ inch and 55,000 pounds in heavier gages is a recent development of the Inland Steel Co., Chicago. This material, of the low alloy, high tensile class, has a minimum ultimate tensile strength of 70,000 pounds per square inch, giving it a high elastic ratio. The elements used give this alloy a high



Single Phase Repulsion Motors. Type R-1 to 5 H.P.



Polyphase Squirrel Cage Motors. Type P-⅛ to 7½ H.P.

. . . Why should **YOU** *buy Peerless Motors?*

A sensible question indeed . . . and the following are a few of the many sensible reasons that answer it.

1. They have style—class so to speak. Will look good with your product.
2. They are powerful and rugged. Will stand plenty of abuse.
3. They are efficient and reliable. Cost less to operate.
4. Standard motors are stocked for immediate shipment. Motors for special voltages or with special features can be supplied in a surprisingly short period of time.
5. They cost you no more, but you get a great deal more.

Let us tell you in greater detail just what we can do for *you*. Write for catalog 105A.

The Peerless ELECTRIC QUALITY COMPANY WARREN, OHIO

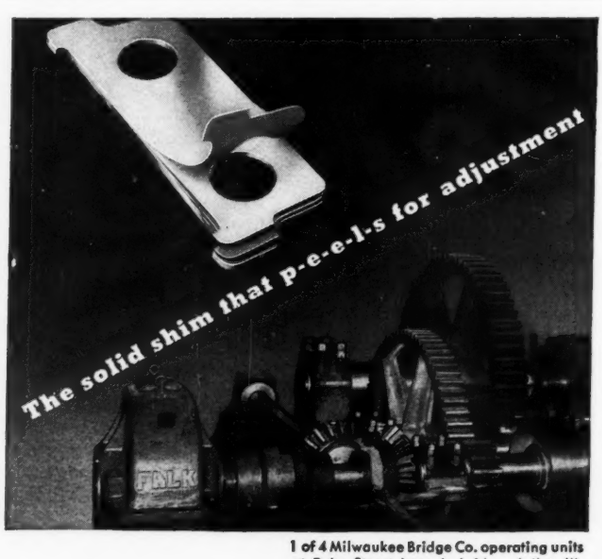
PLASTICS IN DECORATIVE LIGHTING

Translucent molded plastics, in dome lights and instrument panels, add much to the beauty of the new motor car interiors. And they are practical, too—they resist breakage in use; their absolute uniformity insures easy assembly.

These instrument panels were produced for King-Seeley Corporation, of Ann Arbor, Mich.—another of the prominent Middle West manufacturers who entrust their exacting molding jobs to this organization. May we help you with your plastic molding problem?

CHICAGO MOLDED PRODUCTS CORPORATION

2147 Walnut Street Chicago, Illinois



1 of 4 Milwaukee Bridge Co. operating units at Ruby Street bascule bridge, Joliet, Ill.

● precision bearing adjustments

By adopting Laminum shims Milwaukee Bridge Co. provides quick, accurate service adjustment for the life of the equipment.

You simply p-e-e-l one or more .003" laminations at a time from the shim. No filing . . . no miking! Write for sample shim.

THE SOLID SHIM THAT P-E-E-L-S FOR ADJUSTMENT

LAMINUM

LAMINATED SHIM CO., INC. 2126 44th Ave., Long Island City, N.Y.

degree of uniformity and physical characteristics as well as workability. It will bend, form, stamp, seam and weld readily. It is resistant to corrosion. The material will be supplied as sheets, strips, plates, bars and structurals.

Reducers Are for Heavy Duty

TO SUPPLEMENT its line of speed reducers for fractional horsepower motors, Bodine Electric Co., 2264 West Ohio street, Chicago, has developed heavy duty worm gear reducers for all of its N-5 motors. This unit is capable of carrying ¼-horsepower loads continuously. Eight standard gear ratios from 8:1 to 48:1 are offered, and other ratios can be made to special order.

The new reducer can be mounted in practically any position—with motor or shaft horizontal or vertical, with the shaft parallel to or running through the mounting surface, and with the brackets turned for mounting to a horizontal or vertical surface. The shaft may be extended in either direction or in both, and a high speed shaft may be brought out from the motor.

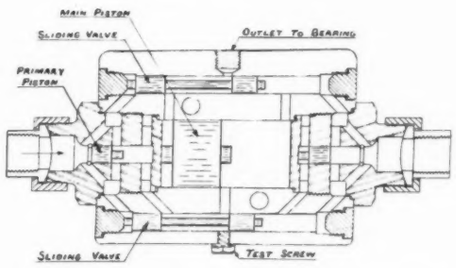
Reducer can be mounted in practically any position, with shaft in a variety of arrangements

Gear housing and motor end shield are cast in one piece, providing a substantial support for the motor, and taking up all thrust forces from the worm. The drive shaft is supported by two double row ball bearings. Sealed type ball bearings, oil slingers, packing and labyrinth seals eliminate all danger of oil leakage.

Feeder Is of Improved Design

EMPLOYING the principle of reversing the direction of flow of lubricant for its operation, the new flat feeder of Trabon Engineering Corp., 1814 East Fortieth street, Cleveland, delivers a measured quantity of lubricant to each bearing at each stroke of the piston pump. In the operation of the feeder, shown herewith, incoming lubricant moves the primary piston and the two sliding valves. The lubricant then follows through the ports and exerts pressure on the main piston, ahead of which is a measured quantity of lubricant ready for delivery to the bearing. The pressure exerted on this main piston is determined by pipe line resistance plus the actual resistance offered by the bearing re-

ceiving lubricant. When the measured quantity is delivered to the bearing, the feeder becomes merely a part of a pipe line and the lubricant leaves the main piston chamber through the



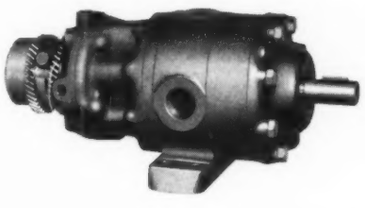
Lubricator employs principle of reversing the flow of lubricant

ports at the other end of the feeder, leaving a new charge of lubricant for the next lubrication cycle. At operation of the next cycle, this action is reversed, the charge being sent to the bearings from the other end of the main piston.

Feeders of this type are constructed with both single and twin outlets which may be used for serving either one or two bearings from the same feeder. The feeder shown is of the single outlet type. The system is never under pressure except when lubricating, and then only enough pressure to overcome line friction and actual single-bearing resistance. A number of the feeders may be operated from the same piston pump.

Hydraulic Drive Includes Two Pumps

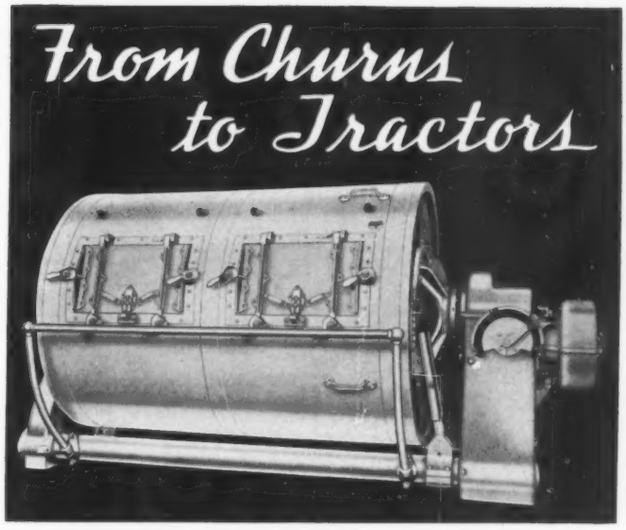
A NEW type of hydraulic pump consisting of a variable displacement pump which gives two adjustable feeds and a constant displacement pump that provides rapid traverse has been introduced by Sundstrand Machine Tool Co., Rockford, Ill. Both pumps are incorporated in a single housing and driven by a single shaft, there being only two revolving parts in the entire mechanism. The variable displacement



Variable displacement pump of an entirely new design is employed in this new hydraulic drive

pump is an entirely new design of the multiple-piston type, which gives a positive uniform feed. Two preset rates are provided, both of which are adjustable throughout their entire range.

The constant displacement pump is a Rota-Roll unit, the operating principle of which com-



For eight years Twin Disc Multiple Disc Close Coupled Clutches have been standard on the Single Rolled Churn and Butter Worker made by Cherry-Burrell Corp., Cedar Rapids, Iowa.

On any kind of a machine—from a churn to a screw machine . . . from a combine to a textile finishing "jigger" . . . from a reverse gear for a marine engine . . . to a power take-off for an oil field rotary drilling rig—you'll find Twin Disc Clutches.

And for a variety of reasons. Because Twin Disc Clutches simplify operation . . . because they effect economies in design . . . because they ensure easier control . . . because they speed up production . . . because they increase output . . . because they transmit maximum power . . . and so on. But most of all for their *unfailing reliability*.

Write* for specific recommendations. Engineering data on request. *Twin Disc Clutch Company, 1325 Racine St., Racine, Wisconsin.

TWIN DISC
CLUTCHES

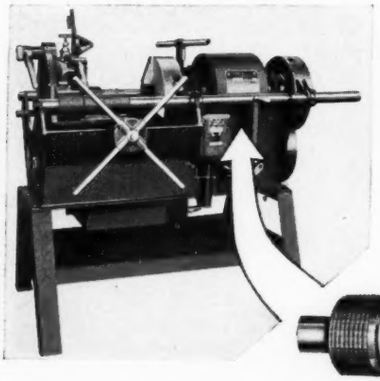
Write for it . . .

● YOUR SAMPLE FILE of the standard types of felt—bound into a chart classifying applications of each type! Designed to be useful to all users of felt—not for sales follow-up. Mailed without charge.

Booth
PRECISION CUT FELT

BOOTH FELT COMPANY, INC. 444—19TH ST., BROOKLYN, N. Y.

PULLMORE CLUTCHES

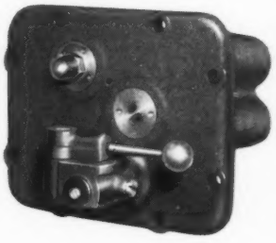


USED IN
TOLEDO
PIPE THREADING
MACHINES

The Toledo Pipe Threading Machine Co., Toledo, Ohio, write us as follows ". . . we are using Pullmore Clutches in several sizes of our Toledo Pipe Threading Machines, and have found them entirely satisfactory in all respects . . .". Letter also states "We examined several makes of clutches and finally selected the Pullmore as being best suited to our needs". Similar statements apply to Pullmore Clutch installations in many other different kinds of machinery. Pullmores are made in many sizes, single and double types, for operation in oil or dry, for transmitting up to 75 h.p. Write today for complete information and the Pullmore Catalog.

ROCKFORD DRILLING MACHINE CO.
Division Borg-Warner Corp.
304 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y. Offices in principal cities

prises a roller that revolves in positive contact with a rotor or ring, like one of the rollers against the outer race in a roller bearing, thus providing a smooth rolling action. Control valve or panel for the drive provides rapid approach, feed, adjustable dwell and rapid return. A second or slower feed may be obtained, and operation of feed and rapid traverse sequence is controlled by adjustable dogs. Jump feed or rapid traverse between intermittent cuts may also be obtained by means of trip dogs. The control valve consists of pilot, reversing and selector valves, all of which are operated from the low-pressure source. In the panel is also the relief valve for both high and low-pressure circuits.



Hydraulic control panel provides rapid approach, feed, adjustable dwell and rapid return

The hydraulic circuit is of the self-locking type which provides smooth uniform feed and shockless high-speed traverses, and which prevents the tool from jumping ahead at the completion of a cut or during an intermittent cut.

Electrode Welds Stainless Steels

ARC WELDING electrodes for welding the group of stainless steels belonging to the 25-12 variety have been announced by Lincoln Electric Co., Cleveland. Because of its higher chrome content the new electrode is particularly advantageous for welding stainless clad steels. This new electrode, known as "Stainweld B," provides the same characteristics as steels containing 25 per cent chromium and 12 per cent nickel. The weld metal has the high corrosion resistance, high tensile strength and ductility possessed by these alloy steels.

Accessibility Is Increased

FAN cooled, totally enclosed direct current motors have been developed with fan and shroud on the commutator end, and with the same accessibility to armature as on straight totally enclosed motors by Westinghouse Electric Mfg. Co., East Pittsburgh, Pa. The removal of but one cover from a bracket opening permits accessibility to the brushes. This is accomplished by casting integrally the inner supporting bearing bracket and the outer air

shroud. The combination bracket therefore has air passageways between the shroud and the inner bracket except at the inspection openings. This construction permits the use of an external blower on the commutator end without the disadvantage of having to remove two covers to examine the commutator. Since the blower is on the commutator end and not the pinion end,

Fan and shroud are on the commutator end in these improved motors

it permits mounting the motor snugly against a gearcase or other wall.

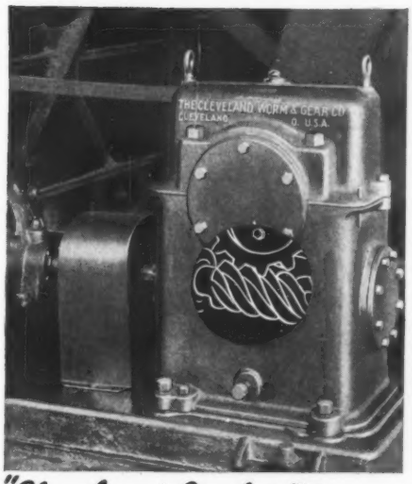
In the design a heavy shroud is placed over the frame to provide a streamlined appearance. This shroud is made an integral part of the frame with pole bolts accessible from the outside. It is not necessary to disturb the shroud in dismantling the motor. The blower is made of cast aluminum with a split hub and is keyed to the shaft. The split hub is drawn down by two bolts, providing a tight fit on the shaft.

Develops Bottle Type Oilers

BOTTLE type oilers in a new style known as "Drip-Drop" for solid, wick or waste-packed bearings are a recent development of Trico Fuse

Necessity for daily oiling is eliminated by unit which drops oil on the bearing from the top as the bearing needs it

Mfg. Co., Milwaukee, Wis. This new oiler, shown herewith, drops oil on the bearing from the top as the bearing needs it and eliminates the necessity for daily oiling by the hand



"Cleveland Quality" Drives at this vital point

HIDDEN *but* TRUSTED

• Whenever you write "Cleveland" into your power drive specifications, you are passing over the responsibility for long years of quiet, dependable operation to equipment *that can take it.*

In this case, trustworthy performance is all the more vital, because few pieces of machine operating parts are more thoroughly hidden away than are these Cleveland Worm Gear units.

Whether installed "outside"—between power-source and driven equipment—or *within* the machine, out of sight, it is rarely necessary to remove the housing cover during the whole life of the machine.

Though the Company is 24 years old, no one yet knows exactly how long a Cleveland Worm Gear Drive will run, under average conditions. Operating reports show that many of the earliest are still in satisfactory daily service.

Assure years of trouble-free performance for your own machines, by specifying "Clevelands" at that vital point between primary power and machine operation. A "Cleveland" Engineer near you will gladly bring valuable facts.

The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

CLEVELAND *Worm Gear Drives*

TRY THIS COUPLING

L-R TYPE "IA"
(U.S. and Foreign Patents Pending)

Manufacturers of motor driven machinery take note! If you want a better, more economical coupling—try this one. Just tell us how you plan to use it—send Shaft Diameter, H.P., R.P.M. We will send you an L-R *Everlasting* FLEXIBLE COUPLING for test. Now made with convex or flaring surface construction for longer life. Made in all standard sizes from ¼" to 10" bores. Send information *now* and we'll send on approval, an L-R *Everlasting* FLEXIBLE COUPLING for you to try out in your own plant under your own conditions of service. Write

LOVEJOY TOOL WORKS
5018 W. Lake St. **Chicago, Ill.**

Books in Popular Demand

Procedure Handbook of Arc Welding Design and Practice
Published by Lincoln Electric Co......$1.50

Diesel Engine Design
By Harold F. Shepherd $3.50

The Engineer's Sketch Book
By Thomas W. Barber $4.50

Machine Designers' Guide
By K. W. Najder $2.50

Plastic Molding
By Louis F. Rahm $3.00

Book of Stainless Steels
(New Edition)
Edited by Ernest E. Thum $5.00

Add 15c for postage

Available from

MACHINE DESIGN
Penton Building, Cleveland, Ohio

336-M.D.

method. The unit is made in three sizes.

The company has also introduced a new addition to its line of Opto-matic constant level lubricators. The new model, known as the No. 3 size, increases the number of possible applications for maintaining constant level lubrication on ring or ball bearing shafts.

Variable Speed Units Motorized

INFINITELY variable speed transmissions with motors built into the unit have been added to the line of equipment being manufactured by Lenney Machine & Mfg. Co., Warren, O. These units make use of the same variable speed transmission presented on page 66 of the December issue of MACHINE DESIGN. They provide speeds adjustable to a fraction of a revolution per minute at any time (before starting or while running).

Water Resistance Is Provided

MOLDED parts with a water resistance never before obtainable are said to be available with a new Durez material, called the 75 series, being offered by General Plastics Inc., North Tonawanda, N. Y. This new phenolic plastic material is designed to give molded parts that will stand up for years despite complete and continual immersion in water. Recent applications include: Containers for semi-liquids, toilet tank valve assemblies and float balls, and a disinfecting device for telephones consisting of a 50 per cent alcohol solution sealed in a cylinder with protruding wick.

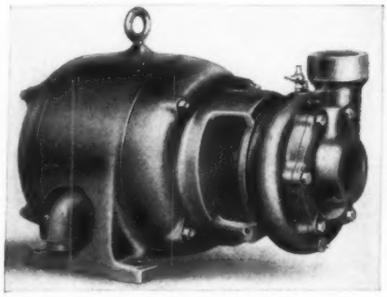
Ball Type Anodes Developed

BALL-TYPE anodes have been made available for copper, brass and zinc plating by Udylite Co., Detroit. The company has produced pure electrolytic copper balls, zinc ball anodes in either pure or alloy zinc and standard 80-20 brass ball anodes (80 per cent copper and 20 per cent zinc). Use of these balls is said to permit maintenance of a constant anode area; elimination of losses; and a convenient method of anoding.

Pump Handles Hot Liquids

DESIGNED especially for handling liquids near their vapor pressures and for hot well service, a new Monobloc centrifugal pump has been developed by Worthington Pump & Machin-

ery Corp., Harrison, N. J., and is known as the type DH unit. This pump, shown herewith, can be used in machinery for power plants, oil refineries, heating systems, air conditioning plants, breweries and similar industries. The pumps are available for capacities from 10 gal-



Liquids near their vapor pressure can be handled by this improved pump

lons per minute against heads of 50 to 110 feet with 12 inches submergence to 175 gallons per minute against heads of 50 to 70 feet with 60 inches submergence. They are compact, the greatest overall floor space required by the largest being only 24 by 16 inches.

Offers New Line of V-Belts

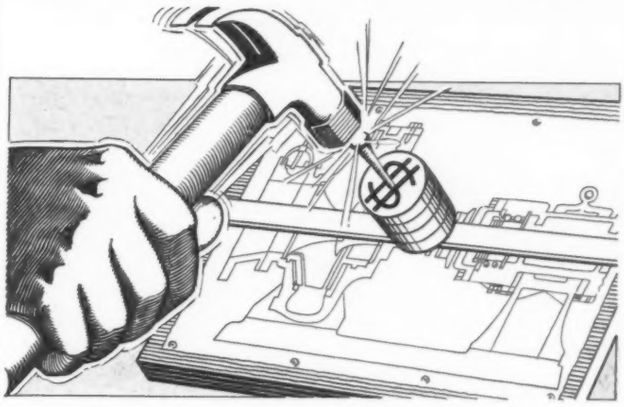
V-BELTS in a complete line for both multiple and single drives are now being offered by B. F. Goodrich Co., Akron, O. The multi-V belts are available in two styles. One is of single strand construction especially designed to withstand flexing and stretching on small pulley, short center, high speed drives. For larger drives, a stronger belt of laminated construction is available which has a greater number of cords and several layers of stiffening fabric.

Belts for single drives have the following construction features: A sturdy cover that resists wear; fabric filler which gives transverse strength without loss of flexibility; rubber-impregnated filler cords built to resist stretch and provide longitudinal strength; and a specially compounded base which acts as a cushion and shock absorbing member.

Employs New Rectifier Tube

A GREATER range of flash speeds is possible with the redesigned Edgerton stroboscope now being offered by General Radio Co., 30 State street, Cambridge, A, Mass. This design, shown herewith, can be used reliably at speeds slightly in excess of 200 per second. It makes use of a more modern rectifier tube, the 83-type. Provision is made in the instrument for flashing the light in exact synchronism with the clos-

THEY NAILED *production costs* at the PACKING POINT*



Before the design could become a practical finished product, a packing was needed. The problem was so tricky that no packing then on the market would meet the requirements.

Called in by the manufacturer, Graton & Knight engineers brought their experience and engineering ingenuity into the picture and designed a special packing from G & K leather.

Now there was more to this special packing than met the eye. For by looking ahead during the design period, the Graton & Knight engineers produced a packing that would hold down production costs during assembly. Thus the product became practical from both the manufacturing and selling angles.

STOPPED AT THE PACKING POINT?

Let Graton & Knight show you where and how the particular problem at your "Packing Point" can be solved. Special packing leathers, laboratory-tested at the **Home of Research** *by Graton & Knight Engineers, are ready to meet such conditions as heat, water, oil, air, semi-corrosive liquids, etc. Prove the superiority of leather for packings to your own satisfaction by writing or wiring for Graton & Knight Leather Packings.*

***THE "PACKING POINT"** is the point in the design of a machine where the problem of packing enters—the point where, we suggest, you consult* **The Home of Research.**

"Creating Success at the Packing Point"

2105

BANTAM

Ball Thrust Bearings

Carried in stock in five types and a wide range of sizes. Our facilities for the production of hardened and ground ball thrust bearings of standard or special sizes from ½″ to 60″ are unequalled. Write for Catalog.

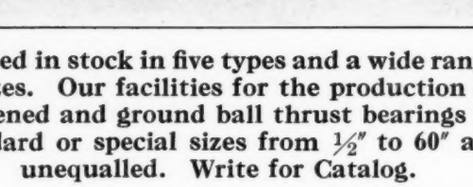
THE BANTAM BALL BEARING CO.
SOUTH BEND, INDIANA

Trade Mark Reg.

Chicago, New Orleans, Dallas, Youngstown, Philadelphia, Seattle, Detroit, Pittsburgh, Toledo, New York, Rochester, N. Y., Washington, D. C.

BBB ONE OR A HUNDRED MILLION 1/32″ TO 60″

THE TAPERED EDGE



SEALS WITH MINIMUM FRICTION

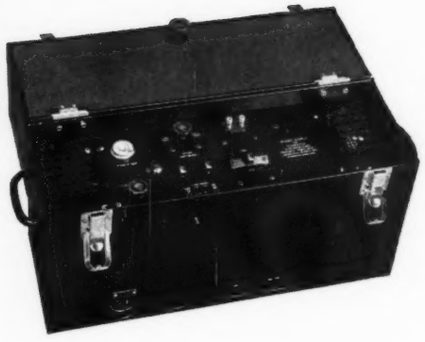
The tapered edge of the leather washer is a vital feature of the Gits Precision Oil Seal.

The leather is so flexible at this tapered edge that only a slight pressure of the flat spring clamp ring, located at this point, is required. Friction on the shaft is therefore reduced to a minimum. Moreover this sharp tapered edge prevents the escape of oil by shearing the oil film.

Send for a descriptive folder.

GITS BROS. MFG. CO.
1861 So. Kilbourn Ave., Chicago, Ill.

GITS Precision Oil Seal

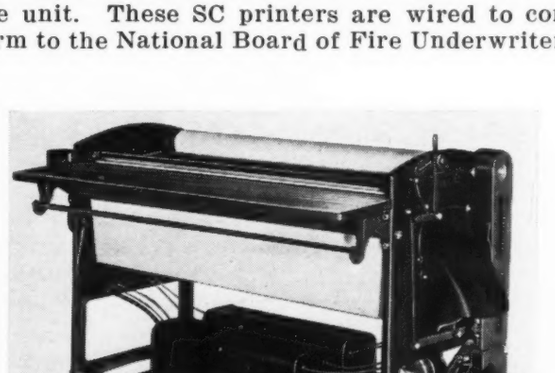


Provision is made in new instrument for flashing a light in exact synchronism with the closing of a pair of contacts

ing of a pair of contacts, by the 60-cycle supply mains (60 flashes per second), or by any external sources of alternating current.

Provides Faster Printing Speeds

FORTY-TWO inch continuous printing horizontal blueprinting machines which can be equipped with either two or three mercury vapor lamps, the three-lamp machine naturally providing faster printing speeds, are a recent development of Paragon-Revolute Corp., 77 South avenue, Rochester, N. Y. Each lamp in the machines extends across the full width of the unit. These SC printers are wired to conform to the National Board of Fire Underwriters



Speed control on new blueprinter provides speeds of from a few inches to six feet per minute

and are provided with proper guards to comply with factory safety regulations.

A conveniently located speed control provides speeds of from a few lineal inches to some six lineal feet per minute. Power is provided by a constant speed motor, transmitted through a V-belt. Feeding table is designed at a height that makes feeding of the paper and tracings a simple operation. A full width canvas belt then carries the work around a semi-circular glass.

Calendar of
MEETINGS *and* EXPOSITIONS

CHANGING of the dates for the automobile shows from January to November has transferred much of the interest of the general public in automobiles to that earlier date. . . . However, the men who make these shows possible still dominate the January scene. . . . From the 13th to the 17th the Society of Automotive Engineers will hold technical sessions in Detroit's Book-Cadillac. . . . Discussions will cover all mechanical parts, bodies, tires and production * * * In addition to the expositions scheduled for January, listed in the following, the new year promises excellent additional opportunity to inspect the results of design ingenuity. . . . In March packaging machines, important attributes to efficient merchandising, will be shown in New York. . . . Also in this month the Railway Appliances association will hold an exhibit of railway machinery in Chicago, tools for a fast-reviving industry.

Jan. 13-17—

Society of Automotive Engineers. Annual meeting to be held at Book-Cadillac hotel, Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary of the society.

Jan. 19-25—

National Canners association. Exhibit of canning and packaging equipment is to be held in conjunction with this meeting at Hotel Stevens, Chicago. E. G. Vail, 205 North Wacker drive, Chicago, is secretary of the exhibit.

Jan. 13-16—

Coin Machine Show. Annual exhibition sponsored by National Association of Coin-Operated Machine Manufacturers to be held at Hotel Sherman, Chicago. C. S. Darling, 120 South LaSalle street, Chicago, is secretary.

Jan. 20-24—

American Road Builders association. Annual meeting and exhibition of equipment to be held at Municipal Auditorium and Exhibition Hall, Cleveland. Charles M. Upham, National Press building, Washington, is managing director.

Jan. 27-31—

International Heating and Ventilating Exposition. Fourth exhibition to be held at International Amphitheatre, Chicago. Information may be obtained by addressing the Exposition at Grand Central Palace, New York.

Jan. 28-31—

American Institute of Electrical Engineers. Winter meeting to be held in New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary.

March 3-6—

American Management association. Annual packaging conference and exhibition of machines to be held at Hotel Pennsylvania, New York. Alvin E. Dodd, 20 Vesey street, New York, is executive vice president.

MACHINES*
of all types are designed by Executives and Engineers who read Machine Design

Adding machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projector
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

***Machines as classified by the United States Census Bureau**

MANUFACTURERS' PUBLICATIONS

BEARINGS—Pillow blocks of an improved type, a new addition to the line of transmission appliances manufactured by SKF Industries Inc., Philadelphia, are covered in a recent booklet of the company. The new pillow block is designed with cross and transverse ribbing to secure the most strength at the least weight and to minimize warping. Another recent publication of the company covers the design of bearings and housings for fans and blowers. Cross sections, cutaway views and design details are given.

CAST PARTS—Physical properties of die castings, graphically illustrated in previous publications of the company, are concisely summarized in *Metalgram* No. 5 of Apex Smelting Co., Chicago.

CONTROLLERS—Jet pipes which can be used to secure exceedingly close control on turbines, engines and other types of machinery are described in a new bulletin of American Askania Corp., Chicago.

CONVEYORS—Chains, sprockets, spiral conveyor, elevator and conveyor parts and transmission machinery are covered in catalog 417 of Jeffery Mfg. Co., Columbus, O.

CONVEYORS—Whitney Chain & Mfg. Co., Hartford, Conn., has prepared bulletin V-126 on its line of platform conveyor chains which include standard steel chain, standard steel links with stainless steel top plates, and all stainless steel chain. The bulletin gives a complete presentation of the chain including applications.

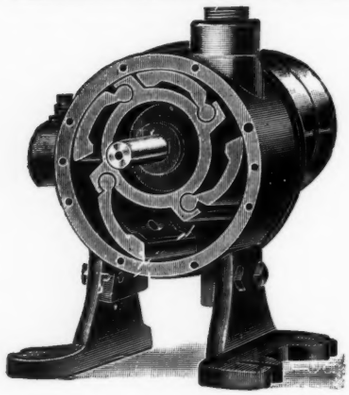
CUSHIONS—Improved types of air cushions for power presses and other machinery are presented in a booklet of Clearing Machine Corp., Chicago. The bulletin illustrates and describes several new developments in the equipment.

DRIVES—Complete details on V-belts and flat belting manufactured by Manhattan Rubber Mfg. Division of Raybestos-Manhattan Inc., Passaic, N. J., are given in a new catalog of the company. Also included are data on packing, molded goods, friction material, rubber coverings and similar products.

DRIVES—Horespower ratings, dimensions, descriptions, illustrations and suggested applications of herringbone gear speed reducers are covered in catalog No. 1519 of the Link-Belt Co., Philadelphia. The booklet covers single, double and triple reduction reducers for large speed ratios and heavy shock loads. All reducers are rated on the basis of the recently recommended practice of the American Gear Manufacturers association. Another booklet of the company, No. 1524, similarly covers the new worm gear reducers of the company. Data presented makes it possible for the designer to select exactly the reducer required for his application.

FITS—The importance of fits and tolerances, classifi-

THE SUCTION THAT LIFTS AND CARRIES YOUR PAPER IN THE PRINTING PRESS, FOLDER, ADDRESSER, LABELLER, SEALER OR BANDER



This is the heart of the machine

And every machine, like every man, is benefited by having a good heart—one that responds when called upon for its best efforts, not one that quits when it is most needed. And in this instance it costs no more when you get a machine with this good heart—the most powerful and long-lasting air pump made.

LEIMAN BROS. PATENTED ROTARY POSITIVE

AIR PUMPS

This is the air pump that is used by manufacturers everywhere on all sorts of Automatic Devices.

They are used for blowing to loosen up sheets of paper on a pile feeder, and we have strainers to prevent oil from spraying on the sheets and on Vacuum Printing Frames.

The printer also uses these pumps for cooling linotype moulds and for blowing dust out of the working parts of machines and out of type cases.

The electrotyper uses the air for agitating his plating solutions, and these pumps are found in almost every plant doing this work. All sorts of shops use them for all sorts of air using devices.

In the big shops, especially in the newspaper plants, these pumps operate the stereotype furnaces creating high heats with gas or oil as fuel.

AND YOUR PRESENT PUMP

Will it maintain its pressure or suction very long?

Our picture showing the inside construction will answer this. These curved wings scoop up the air as they rotate. Centrifugal force holds them out against the cylinder while in motion, and so they are always snugly fitted, no matter how old they may be.

Any machine can be fitted with this pump if you insist on it.

Ask for Free Information

LEIMAN BROS., INC.

177 (1) CHRISTIE ST., NEWARK, N. J.

LEIMAN BROS., N. Y. CORP., 23 P1 WALKER ST., NEW YORK CITY

MAKERS OF GOOD MACHINERY FOR OVER 45 YEARS

cation of fits, and means of measuring to close limits are presented in an interesting booklet of the Dumore Co., Racine, Wis., entitled "1/10,000th of an Inch."

FRICTION MATERIALS—A summary of all the ordinary industrial applications of friction materials, detailed explanations of the types and technical data on each type are presented in a new catalog of Manhattan Rubber Mfg. Division of Raybestos-Manhattan Inc., Passaic, N. J.

GEARS—Worm gears for power transmission, the principles controlling design, ratios available, efficiencies, lubrication and similar topics are covered in a recent reprint being distributed by DeLaval Steam Turbine Co., Trenton, N. J.

INSTRUMENTS—Industrial thermometers which may be built into the machine to give accurate indication of the interior temperature at all times are described in a bulletin of Ideal Commutator Dresser Co., Sycamore, Ill.

IRON—Properties of Toncan iron are given in a recent booklet of Republic Steel Corp., Cleveland, which includes details on the benefit afforded by various alloying elements, physical properties, applications, and forms available.

IRON—Physical properties and characteristics of Arcade Z-Metal and presented and compared with similar properties of other materials in a new chart on the material issued by Arcade Malleable Iron Co., Worcester, Mass.

LUBRICATION AND LUBRICATING EQUIPMENT—Trabon Engineering Corp., 1814 East Fortieth street, Cleveland, has prepared two new bulletins on its line of positive centralized lubrication equipment. Included in the bulletins is a description of the new flat feeder employed in the devices.

PLASTICS—General Plastics Inc., North Tonawanda, N. Y., is distributing Vol. 1, No. 1 of its new publication *Durez News*. This booklet presents applications of plastic molding both by descriptions and by photographs.

PUMPS—Brown & Sharpe Mfg. Co., Providence, R. I., has prepared a circular on its line of rotary geared pumps with helical gears which permit higher speeds than pumps with spur gears.

SHAPES—Methods by which a number of parts were improved and production simplified are presented in a new bulletin of Union Drawn Steel Co., Massillon, O.

STEEL (NICKEL-CLAD)—A complete presentation of nickel-clad sheets, their properties, their characteristics and all other details is included in a new bulletin of Lukens Steel Co., Coatesville, Pa. The bulletin is profusely illustrated with photographs of machines on which these clad steels have been applied.

WELDED PARTS AND EQUIPMENT—The strength of welded joints including the safe allowable loads for fillet welds in shear, properties of weld metals and mild steel and the length of fillet welds are discussed in Application Sheet No. 46—Series 2 of Lincoln Electric Co., Cleveland.

WELDED PARTS AND EQUIPMENT—Production facilities of Hobart Bros. Co., Troy, O., and the steps performed in the production of welders built by the company are presented pictorially in a recent publication of the company.

DO YOU KNOW

1. The methods used to control the speeds of electric motors and the many combinations that are possible?
2. How plants with alternating-current power are gaining the advantages of adjustable-speed motor-drive?
3. How straight-run layouts of machines with tandem (or range) drives can be made to keep material on the move with less handling?
4. That speed ranges up to 40 to 1 are obtained with certain combinations of d.c. control?
5. How a constant tension can be maintained while processing cloth, paper, steel, etc.?
6. How the control features provided with up-to-date motor-drive aid production?

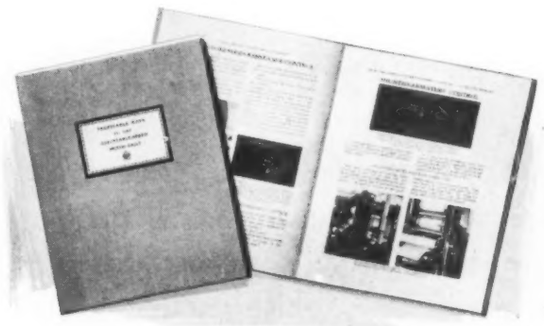
Answers to these and similar questions of equal interest are given by text, diagrams, and pictures in our book—Profitable Ways to Use Adjustable-speed Motor-drive.

Use the coupon to obtain a free copy.

Reliance Electric & Engineering Co.

1050 Ivanhoe Road Cleveland, Ohio

***Branches*: Birmingham, Boston, Buffalo, Chicago, Cincinnati, Detroit, New York, Philadelphia, Pittsburgh**



"PROFITABLE WAYS TO USE ADJUSTABLE-SPEED MOTOR-DRIVE"

A book designed to be helpful and to stir your thoughts.
Easy to read—32 pages—70 illustrations.

Please send me without obligation a copy of your book "Profitable Ways to Use Adjustable-speed Motor-drive".

Name.....

Title or Dept.....

Company.....

.....

Street.....

City..... State.....

Silver Anniversary

1911 **25 YEARS AND** 1936

500,000

Viking Rotary Pumps

Starting with a one room factory and two men in 1911, the Viking Pump Company has, in the ensuing years, developed into the world's largest exclusive manufacturer of rotary pumps.

The soundness of Viking's Simple "Gear Within a Gear—Two Moving Parts" Principle—the sturdiness of Viking construction, are proved by the fact that there are approximately 500,000 Viking Rotary Pumps in successful operation today.

VIKING PUMP CO., Cedar Falls, Iowa

1935 INDEX

The index for 1935 issues is ready for distribution. In addition to the usual contents index, a combined itemized index, which considerably simplifies the finding of material on a specific subject, is included.

There is no charge for the index. However, it will be sent only to those readers who previously have requested a copy of each index as published, and to those writing in for this particular copy. MACHINE DESIGN, Penton Building, Cleveland.

INDEX TO ADVERTISERS

Allen-Bradley Co.	Inside Front Cover
American Engineering Co.	54
Baldor Electric Co.	58
Bantam Ball Bearing Co.	76
Bethlehem Steel Co.	*
Bodine Electric Co.	57
Booth Felt Co.	72
Brown & Sharpe Mfg. Co.	68
Bruning, Charles, Co., Inc.	13
Carnegie-Illinois Steel Corp.	*
Century Electric Co.	61
Cleveland Worm & Gear Co.	73
Chicago Molded Products Corp.	70
Chicago Rawhide Mfg. Co.	4
Climax Molybdenum Co.	14
Cutler-Hammer, Inc.	Back Cover
Diamond Chain & Mfg. Co.	*
Dietzgen, Eugene Co.	Inside Back Cover
Dumore Co.	65
Emerson Electric Co.	*
Fafnir Bearing Co.	63
Fairbanks, Morse & Co.	53
Felters Co., Inc.	15
Foote Bros. Gear & Machine Co.	*
Formica Insulation Co.	*
Garlock Packing Co.	*
General Electric Co.	82
General Electric Vapor Lamp Co.	12
Gits Bros. Mfg. Co.	76
Graton & Knight Co.	75
Hamilton Manufacturing Co.	*
Hilliard Corp.	68
Holtzer-Cabot Electric Co.	66
Hoover Steel Ball Co.	*
Howell Electric Motors Co.	*
Hyatt Roller Bearing Co.	59
Imperial Electric Co.	*
International Nickel Co.	55
James, D. O., Mfg. Co.	16
Korfund Co., Inc.	*
Laminated Shim Co., Inc.	78
Leiman Bros., Inc.	78
Lincoln Electric Co.	*
Linde Air Products Co.	8
Link-Belt Co.	3
Lovejoy Tool Works	74
Marlin Rockwell Corp.	49
Master Electric Co.	18
Michigan Leather Packing Co.	62
Morse Chain Co.	9
New Departure Manufacturing Co.	6
New Jersey Zinc Co.	51
Norma-Hoffman Bearings Corp.	52
Peerless Electric Co.	69
Reeves Pulley Co.	17
Reliance Electric & Engineering Co.	79
Rivett Lathe & Grinder Corp.	*
Rockford Drilling Machine Co.	72
Roper, Geo. D., Corp.	64
Shafer Bearing Corp.	67
Shakeproof Lock Washer Co.	60
Sherwin-Williams Co.	56
Standard Pressed Steel Co.	66
Summerill Tubing Co.	*
Timken Roller Bearing Co.	*
Twin Disc Clutch Co.	71
Union Carbide & Carbon Corp	8
Vickers, Inc.	10, 11
Viking Pump Co.	80
Wilmington Fibre Specialty Co.	*

*Advertisements appear in previous issues.

Business and Sales Briefs

G. S. CRANE, sales manager, Cutler-Hammer Inc., Milwaukee, has been elected a vice president of the company. Mr. Crane will continue as head of the sales department. He has been with the company more than twenty-five years, for some time serving as manager of the Cleveland office.

* * *

J. H. Crawford is now manager of the construction materials sales division of the General Electric Co., succeeding the late Frank W. Hall.

* * *

Emerson Electric Mfg. Co., St. Louis, has opened a branch sales office at Suite 316, Stormfeltz-Loveley building, Woodward and Grand boulevard, Detroit.

* * *

Paul W. Hewitt is now associated with the sales department of Chicago Pneumatic Tool Co. and will be located at the Chicago office, 3655 Iron street, Chicago.

* * *

Benjamin C. Bradford, district sales manager at St. Paul, Minn., for Inland Steel Co. for the past thirty-two years, has retired. Ervin J. Sanne has been appointed as successor to Mr. Bradford.

* * *

H. W. Wilson Co., Newark, N. J., manufacturer of thermostatic bimetal and electrical contact points, has begun an expansion program involving a three-fold increase in manufacturing capacity to accommodate the increased demand for its products.

* * *

The name of Whitney Mfg. Co., Hartford, Conn., manufacturer of roller, silent, block and conveyor chains and sprockets, has been changed to The Whitney Chain & Mfg. Co. No change in company policy or product is involved.

* * *

Charles L. Hyland, 11 West Monument avenue, Dayton, O., has been appointed sales representative in the Springfield, Dayton and Cincinnati territory by the cold drawn bar division of Western Automatic Machine Screw Co., Elyria, O., to handle sales of cold finished bar steel in carbon and alloy grades as well as carbon and alloy wire.

* * *

Leland Electric Co., Dayton, O., manufacturer of fractional horsepower motors, has appointed E. B. George general manager of the company. Mr. George has been in turn sales engineer, sales manager and vice president. H. V. Butterfield has been appointed general manager of the Canadian affiliate of the Leland company, Leland Electric Canada Ltd.

* * *

Carboloy Co., Detroit, has transferred Ray Mack from the general offices at Detroit to the Chicago district office as an addition to the sales personnel covering Northern Indiana and Illinois. J. C. Kent, now in the Detroit district office, will be added to the sales personnel covering the Southern Michigan territory. J. E. Weldy, Minnesota representative, is to be transferred to the Detroit district office as assistant to the Detroit district sales manager.

* * *

Cleveland district sales offices of Republic Steel Corp. have been removed to 920 Republic building. W. E. Collier continues in charge of the offices as district sales manager. T. S. Johnson has been appointed as sales metallurgist for the Republic company, pig iron division, Youngstown, O.

CROSS SECTIONS

A FACT that designers should consider carefully is that it is not the heavy machinery in power plant and pumping stations that must take the most abuse and stand the heaviest pounding. Domestic machinery and office equipment receive less attention than any other class of equipment, and so must be designed to withstand more severe conditions than those usually encountered by heavy machinery.

MACHINE tool designers are being given an opportunity to make the hobby of photography pay. A contest has been opened in which $25 will be first prize for interesting and unusual pictures of machine tools taken by the employe of the builders of these tools.

NO BETTER picture of progress in the design of machinery and instruments can be found than a comparatively insignificant line in the news reports on the recent blizzard, the most severe the Mid-West has seen in years. This line, at the end of the article, said "Airline traffic at the airport was not interrupted." Could this have been true just a few years ago?

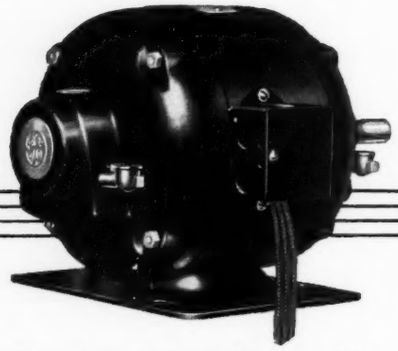
ALBERT FOSTER'S comments on engineering training on page 42 of the December issue have aroused considerable comment. We'll be pleased to get your letter. It's a big problem, and no group is better able to solve it than the men now engaged in engineering. Think it over and drop us a line!

WITH all the promotion that amateurs have been getting lately, we have been waiting with fear and trembling in anticipation of the glorification of the amateur machine designer. We're lucky that this is one field in which the amateur hasn't a chance. Designing machines is a he-man job that requires a great deal of study, care, and knowledge of as many parts and materials as a man can assimilate.

MANUFACTURERS of machines, parts and materials are rapidly evincing an increased interest in the activities of the administration at Washington. After all, the best design ever made is of no use unless it can be sold, and administration policies tending toward the raising of costs will have an important effect on sales. One careful analysis we recently received was "Debasing the Currency," by E. S. Pillsbury. This most complete review of the problem is worthy of study by every engineer. We'll arrange to have a copy sent you if you wish it.

WHICH FRACTIONAL-HORSEPOWER MOTOR FOR POLYPHASE POWER SUPPLY ?

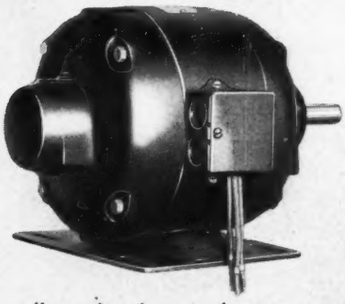
THE G-E POLYPHASE MOTOR, TYPE K, FOR GENERAL APPLICATIONS



For all-round use. A thoroughly dependable squirrel-cage motor that will give years of reliable service. Mounting dimensions are interchangeable with those of single-phase motors

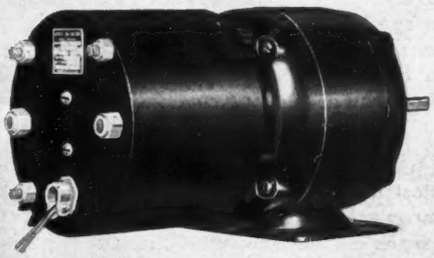
THIS sturdy motor is available in a variety of mechanical modifications (as, for example, some of the types illustrated above) which will meet the power requirements of your design. Its ratings, from 1/8 to 3/4 hp inclusive, offer you a wide range from which to choose. Whether you require a standard or a special fractional-horsepower motor, General Electric has a type that will correctly meet your needs.

The Type K motor for polyphase power supply is but one of the large variety of G-E fractional-horsepower motors. It is a thoroughly dependable squirrel-cage motor that will give years of reliable service. Mounting dimensions interchangeable with those of other G-E fractional-horsepower motors assure you maximum value. For further information, communicate with General Electric Company, Schenectady, N. Y.



A totally enclosed motor that is protected against dust, dirt, mild chemicals, and moisture. A motor which has a long, carefree life

A gear-motor for low-speed requirements. It offers you unusual economies in installation and operating costs. Ready for direct connection to your machine



For stop-and-start applications, such as hoist, door operators, and other applications where a brake is required, this equipment will give you long service life and simplify installation

070-100

GENERAL ELECTRIC